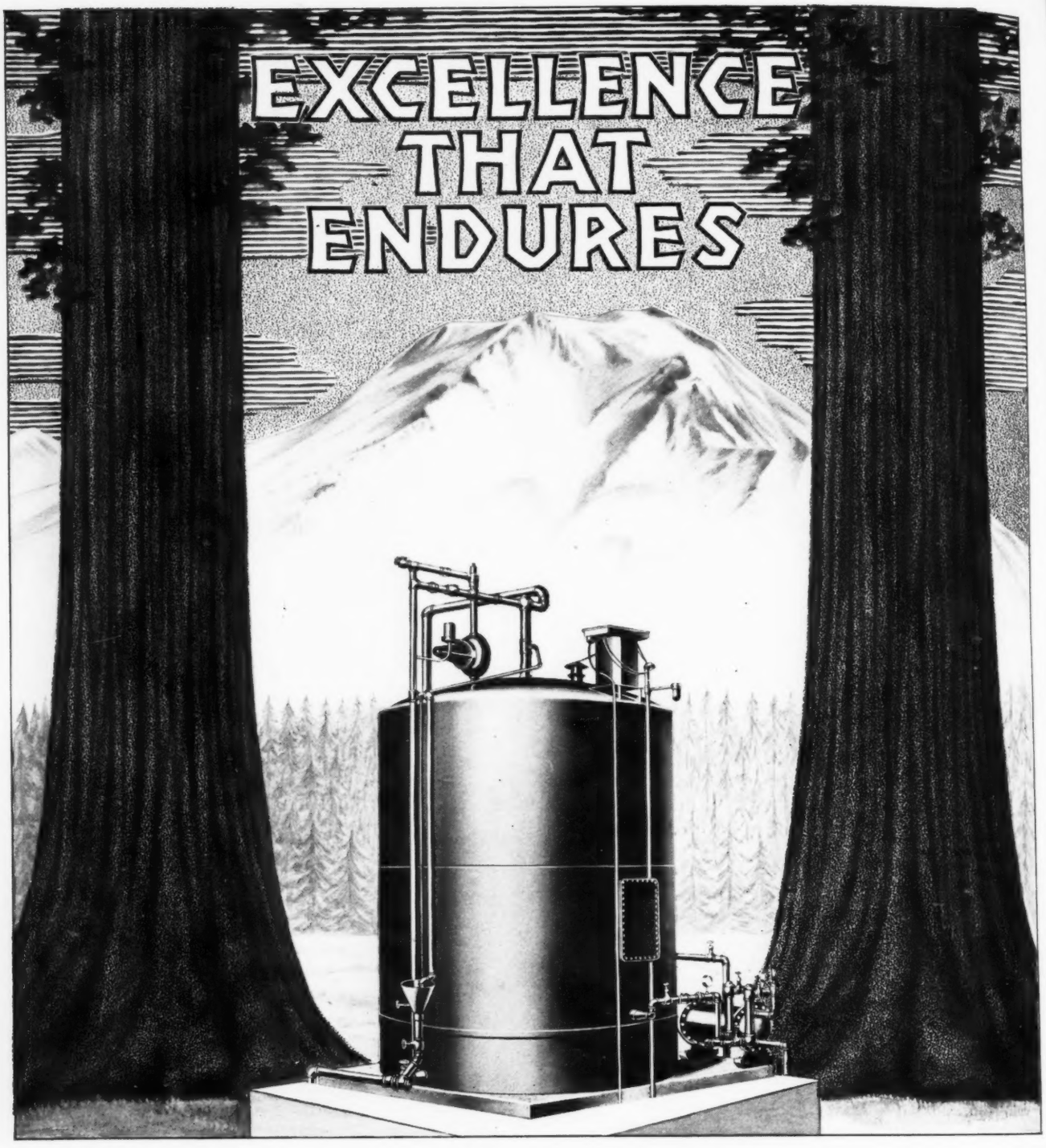
DALLAS, TEXAS AUGUST, 1932

An Oil Country Storm at Night

THE ENGINEERING MAGAZINE OF THE OIL AND GAS INDUSTRY



PETRECO

REG. U.S. PAT. OFF.

The Electrical Process of Dehydrating Crude Oil Emulsions; first used commercially in 1909

(Fully Covered by Process and Apparatus Patents)

PETROLEUM RECTIFYING CO. of CALIFORNIA, LOS ANGELES, Branch: HOUSTON, TEXAS

The Petroleum Engineer

Published 13 times a year; monthly on the 15th with the exception of June, in which two issues appear—the Engineering Review number on the first and the regular June issue on the 15th.

The Engineering Magazine of the Oil and Gas Industry

Edited and Circulated Only for those Actively Engaged in the Operating Departments of the Industry

SUBSCRIPTION PRICE
Single copies 15 cents. Domestic and foreign, $1.00 per year, with the exception of Canada, where the price is $1.65 per year.

Volume 3 | AUGUST, 1932 | Number 12

This Issue Contains

	Page
The Month's High Lights in Oildom — By J. L. Dwyer	11, 12 and 13
Gas Engines and Motors Power Station Designed for Varying Loads — By J. H. Dameron	26
The Effects of Oxidation on Lubricating Oils — By H. B. Batchelor	28
Modern Equipment and Methods Used on World's Deepest Cable Tool Hole — By Warren L. Baker	29
Developments in Cracking Plant Equipment — By F. R. Staley	31
Anchored Tubing Proves Effective — By W. A. Sawdon	33
Largest Single Span Natural Gas Pipe Line Bridge — By Gordon R. Lunt	35
Cracking Plant Temperature Control	37
Spraying Molten Metal to Combat Corrosion	38
Operating Features of One of California's Largest Natural Gasoline Plants — By Robert V. New	44
New Clean-Out Tool Attracts Attention	48
New Method of Applying Insulation to Oil Field Boilers	51
Furnace Wall Construction — By George P. Reintjes	53
Mud Plug Seals Gasoline Line During Welding Repair	55
Selecting the Proper Motor Frame for the Application — By T. D. Williamson	78

REGULAR DEPARTMENTS

Latest Activities in the Oild Felds	14, 15 and 17
Progress of Major Pipe Line Work	18 and 20
The Month's Activities in Refining	22
Strange But True Happenings in the Petroleum Industry	46
Running Tour with Men in the Industry	64 and 67
New Petroleum Equipment	57, 59, 61 and 62
Laugh with Barney	68
New Petroleum Literature	70
New Patents of the Industry	80

SPECIAL NOTE: Each issue of The Petroleum Engineer is copyrighted. Any republication of the matter appearing in the magazine, either wholly or in part, is not permitted except by special authorization.

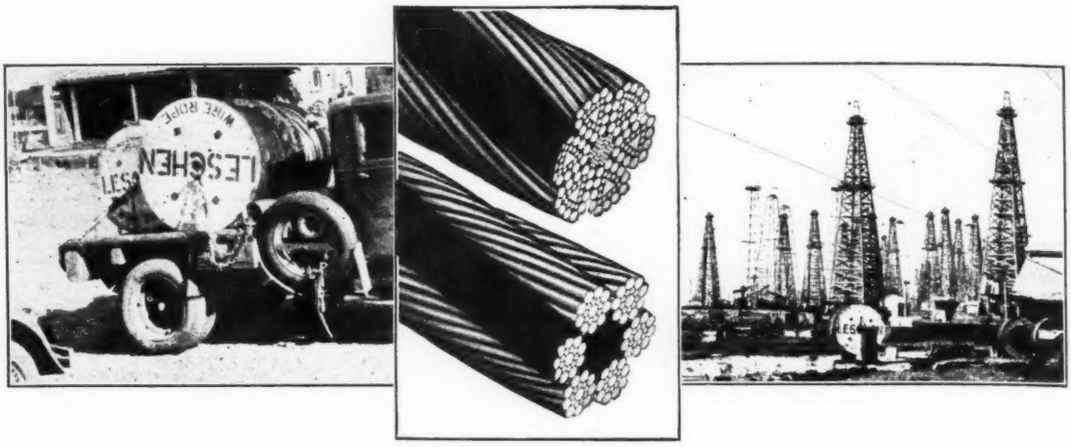
THE PETROLEUM ENGINEER PUBLISHING CO.

Tower Petroleum Building • Dallas, Texas

C. Morris - - - - - - - - *President-General Manager*
J. L. Dwyer - - - - - - - - *Vice-President-Editor*
T. J. Crowley - - - - - - - - - *Vice-President*
W. T. Bryan - - - - - - - - *Secretary-Treasurer*
W. L. Love - - - - - - - - *Advertising Manager*
K. C. Sclater - - - - *Oil and Gas Production Editor*
J. H. Dameron - - - *Oil and Gas Transportation Editor*
F. R. Staley - - - *Refining and Natural Gasoline Editor*
Warren L. Baker - - - - - - - *Associate Editor*
C. R. Barrett - - - - - - - *Circulation Manager*

California Representative: J. H. Tinkham
2941 Raymond Ave., Los Angeles, Calif. Phone, PArkway 3925

Member Audit Bureau of Circulations
Member The Associated Business Papers, Inc.



You Can Depend on "Hercules" [Red Strand] Wire Lines

There are definite reasons why this wire rope is so dependable and long-lasting, some of which are:

(1) It is made of acid open-hearth steel wire.

(2) Every wire put into it first rigidly tested by us to make sure that it meets our exacting requirements.

(3) Our manufacturing methods and machines insure even tension on both the wires and the strands.

(4) It is made in both Round Strand and Patent Flattened Strand constructions as no one type of wire rope is suitable for all conditions encountered in the Oil Felds.

1857 - 1932
75th
ANNIVERSARY
A. LESCHEN & SONS
★ ROPE CO. ★

"HERCULES" **(Red-Strand)** Wire Rope is furnished in rotary lines, cable-tool lines, casing lines, sucker rod lines, swabbing lines and tubing lines. Ask our nearest distributor for further information on this money saving wire rope. . . . . .

Made Only by **A. Leschen & Sons Rope Co.** Established 1857

ST. LOUIS . . 5909 Kennerly Avenue

NEW YORK . . . . . 90 West Street
CHICAGO . . . 810 W. Washington Blvd.
DENVER . . . . . 1554 Wazee Street
SAN FRANCISCO . . . 520 Fourth Street
LOS ANGELES . . . . 2416 E. 16th Street

Distributors:

CASEY & NEWTON
1106 Benedum Trees Building
Pittsburgh, Pa.

HINDERLITER TOOL COMPANY
Tulsa, Okla.

NORVELL-WILDER SUPPLY COMPANY
Beaumont, Texas

OSBORN MACHINERY COMPANY, *Inc.*
Clarksburg, W. Va.

PARKERSBURG SUPPLY COMPANY
Parkersburg, W. Va.

UNITED PIPE AND SUPPLY COMPANY
Charleston, W. Va. : Paintsville, Ky.

The Month's HIGH LIGHTS in OILDOM

By J. L. DWYER

THE consensus of opinion expressed by leading oil men is that the oil industry is now fairly well stabilized and is making progress toward further recovery, but at the same time, it is emphasized that curtailment of crude oil output must continue and that perhaps additional curtailment may be necessary this winter.

Stabilization of the industry is best shown by the recently published earnings statements of large independent and major companies. Many of the new statements show that the oil companies are on the profitable side of the ledger for the first time in many, many months, while other companies, not quite so fortunate as to get on a profit-making basis, nevertheless were able to show substantial improvement in their second quarter statements. Some companies have been able to net profits despite the fact that most of their production has been in areas heavily prorated.

Another factor pointing to the improvement in the industry has been the balance maintained between production and demand. There has been some withdrawals from crude storage during the first half of the year and now, with the gasoline situation showing improvement, the present prices for oil may be expected to hold during the winter. If this condition does prevail, company earnings statements for the year will be considerably improved over last year and the industry will enter the year 1933 in an immensely improved condition over 1932. The most important thing now apparently before the industry is the necessity of curtailing crude oil runs to stills. This must be accomplished before the decreased winter consumption to avoid the piling up of huge gasoline stocks.

A new commercial oil producing state was added to the nineteen previous oil states of the Union when a 300-barrel well was completed in Mississippi. The new well is south of the Jackson gas field and promises considerable development for the state, which has been a gas producer for several years.

Drilling operations in the East Texas field continue to hold up to their high number, despite the fact that there is a growing shortage of pipe line connections. The pipe line connection problem is becoming acute because of the rapid completion of wells and apparently there will soon be a large number of wells without connections. Pipe line companies report they cannot take on many more connections and already there are something like fifty wells without transportation facilities. Every effort is being made to secure connections for new wells so as to prevent undermining of the price structure by companies that desire to ship by tank cars at low prices. Attempts are also being made to persuade operators to slow up drilling, but thus far this has been unfruitful. However, drilling operations are expected to commence declining this fall.

Reduced production in California has removed practically all "free oil" from the market. This condition has nearly finished the gasoline war which has prevailed throughout the state for the past year. With crude production being held at around 470,000 barrels daily, it is being nicely absorbed. Apparently the California situation will continue to hold as drilling in the state is at a very low ebb with no field at present giving indications that any big campaign will be commenced.

Production and Refining Figures Furnished by the American Petroleum Institute

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending July 27, 1932

(Figures in Barrels of 42 gallons each)

DISTRICT	Per Cent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	457,700	72.2	19,783,000	7,677,000
Appalachian	91.8	93,900	68.3	2,350,000	1,121,000
Ind., Ill., Ky.	98.9	296,000	68.6	8,190,000	4,393,000
Okla., Kans., Mo.	89.6	231,700	53.2	5,360,000	3,467,000
Texas	88.1	506,400	60.0	6,919,000	10,757,000
Louisiana- Arkansas	98.5	143,200	60.2	2,205,000	5,395,000
Rocky Mountain	89.4	42,700	29.7	1,863,000	639,000
California	96.7	491,800	55.6	15,785,000	98,761,000
Total Wk. July 27	95.1	2,263,400	61.8	62,455,000	132,210,000
Total Wk. July 16	95.1	2,228,000	62.5	62,552,000	132,635,000
The Texas and Louisiana Gulf Coast figures shown below are included above in the totals of their respective states					
Texas Gulf Coast	99.8	403,400	75.9	5,260,000	8,302,000
La. Gulf Coast	100.0	98,600	66.8	1,964,000	4,711,000

Daily Average Production

(Figures in Barrels)

	July 23, 1932	June 25, 1932	July 25, 1931
Oklahoma	454,450	426,900	482,150
Kansas	96,550	98,300	97,400
Panhandle Texas	53,850	55,850	55,600
North Texas	49,600	50,400	58,100
West Central Texas	24,550	24,400	25,600
West Texas	177,500	178,950	199,650
East Central Texas	57,550	57,350	52,350
East Texas	345,500	331,800	504,900
Southwest Texas	56,000	56,000	56,750
North Louisiana	29,903	29,850	33,450
Arkansas	34,150	34,000	40,600
Coastal Texas	116,900	116,450	133,950
Coastal Louisiana	32,450	31,900	22,550
Eastern (Not including Mich.)	103,600	104,650	97,300
Michigan	18,850	17,650	7,800
Wyoming	35,900	35,000	40,600
Montana	7,700	7,200	7,950
Colorado	2,850	2,950	4,200
New Mexico	36,100	36,100	42,150
California	471,900	460,400	523,900
TOTAL	2,205,850	2,156,100	2,486,950

NOTE: Stocks at refineries, except in California district, which includes stocks of finished gasoline and engine distillate at refineries, water terminals and sales distributing stations and amounts in transit thereto.

Oil Company Earnings Statements Show Improvement

The most optimistic industrial report is the quarterly statement by a number of the oil companies. In practically all instances oil company reports issued thus far have shown a remarkable improvement over those for the first half of last year, while the statements for the second quarter of this year are much better than the ones issued for the first quarter. Not all of the companies were able to show net profits after all charges and reserves, but those which had net losses showed operating profits in most cases and much smaller net losses than in 1931.

Many of the companies' statements reflect the higher price schedules for crude oil. With legalization of the proration movement it is unlikely that crude production will again get entirely out of hand, so the present prices may expect to hold good for the remainder of the year, in which case the annual statements will be materially better than those issued at the close of 1931.

Among the companies showing improved statements are: Amerada Petroleum Corporation, Atlantic Refining Company, Barnsdall Corporation, Consolidated Oil Corporation, Continental Oil Company, Mid-Continent Petroleum Corporation, Phillips Petroleum Company, Pure Oil Company, Skelly Oil Company, Tide Water Associated Oil Company, Texas Pacific Coal & Oil Company, Sun Company, Standard of California, and Shell Petroleum Company.

Gasoline Gallonage Better Than Expected

While there is evidence that the total motor fuel gallonage of the country this year will show a loss from last year, it will be far less than the more pessimistic predicted last winter.

According to tabulations made by the Western Petroleum Refiners' Association, gasoline gallonage in some parts of the country is increasing while dropping in others. These tabulations are bases on gasoline sales tax collections for the first four months of the year.

There is evidence of a recession of the depression in the North Atlantic States, where an increase in consumption gasoline has been recorded. The Association has found an increase in gasoline sales in all of the New England States, together with New York, New Jersey, Pennsylvania, Maryland, Delaware, District of Columbia, Virginia, West Virginia, Indiana and Illinois.

The gain in West Virginia was the least, being one-half of one per cent. Delaware's gain of 20.6 per cent was highest.

The states showing increases are industrial states, where it has been presumed that the depression has had the most effect. They are the only ones to show increase save Nevada. The principal losses are in the Northwestern and Middle-Western grain states.

Sinclair Buys Richfield Oil Company

An offer equivalent to $22,862,000 for assets of the Richfield Oil Company, made by Harry F. Sinclair's Consolidated Oil Corporation, has been accepted by the committee representing Richfield bondholders, Pan-American bondholders and unsecured Richfield creditors.

The total amount involved might run higher than the $22,862,000 as the offer included up to $5,000,000 to satisfy dissenters to the reorganization plan.

Because actual consummation of the transaction is conditional on a sufficient number of assenters, a program will be submitted to individual bondholders and creditors by an appointed committee.

Seubert Discusses the Depression

Edward G. Seubert, President, Standard Oil Company (Indiana), in a message to stockholders and employees, stated:

"Talk is heard that there never will be an economic recovery, that still worse times are ahead, that the country is, in fact, going straight to the dogs. As has happened in other times of depression, it has become more or less common to hear loose gossip about the stability of the institutions of our civilization. * * * It becomes necessary to oppose destructive talk by constructive thought and action, to meet agitation with calm and courageous reassurance.

"Current conditions call for adoption by patriotic citizens of something like the same aggressive attitude in protecting his country, his home, and the order of which he is part that he shows especially in time of war.

"No matter how bad the current depression may be, we know that it is going to end sooner or later. It has shown no developments, except possibly in degree of intensity or ill effects, that have not been experienced in past depressions in the country's history. A return to better conditions is bound to occur eventually in this instance as in the past.

"Meanwhile, our job—the job of all good citizens—is to meet the situation as best we can, striving always to exert any influence we can toward improvement.

"* * We are in the grip of something too large for our company or any group of companies to control. Whatever we do can affect the general situation only in small part. We are trying to do our share toward ending the depression. The combined efforts of thousands of organizations toward that end will eventually succeed.

"Our most immediate task is to keep up our morale as individuals and as a company. Every one of us, even if in the most difficult situation ever experienced, must square his shoulders and meet the problem without loss of faith or courage."

Octane Number May Set Crude Price

Octane ratings for gasoline are trending in the direction of similar ratings for crude oil. The policy of paying for crude on a basis of octane properties rather than exclusively on gravity is already in effect in parts of the Mid-Continent.

It has started quite a fight at Hobbs, New Mexico, where a price is being paid below that given in certain West Texas fields. Governor Seligman has taken up the fight in behalf of the producers because of the state's interest in the field as a landowner as well as guardian of public interests. The difference in the prices paid has been explained by the statement that the West Texas crude ranks higher in octane value.

A. P. I. Starts East Texas Probe

Forms for checking up on the movement of oil through East Texas pipe lines have been drawn up by the American Petroleum Institute committee appointed to investigate alleged oil thefts in the field. Several lengthy discussions have been held by the committee members.

A tremendous amount of detail is involved in the check on the various pipe line companies, with thousands of connections to be reported on and many other details to be investigated in connection with disposal of the oil.

The committee has three purposes, according to Jack Pew, Sun Company, Dallas, who is chairman. These are: First, to determine what quantity of oil is being produced illegally in East Texas daily; Second, to learn to what extent the facilities of the pipe line companies are being used in disposing of this oil, and, Third, to suggest remedies for the situation.

Texas Company Laying Line to Conroe Area

The second major company to furnish an outlet for production in the Conroe area, Montgomery County, Gulf Coast Texas, is The Texas Pipe Line Company. This company has commenced work on its line to the field.

Humble Pipe Line Company already has its eight-inch line completed and is taking 400 barrels daily from each completed well.

Mississippi Well Good for 300 Barrels Daily

A well belonging to Henslee et al, one and one-half miles south of the Jackson, Mississippi gas field, is estimated to be good for 300 barrels daily. It is producing from a chalk formation topped at 2465 feet. The oil tests 14 gravity. This is the first commercial oil well in the state.

East Texas Pipe Line Connections are Scarce

The East Texas Pipe Line Committee reports that out of a total of 54 producers without outlet for production the first part of August, that connections have been secured for only about 25 of them. The balance were not promised and some of them were not even considered by purchasing companies.

Heretofore, this committee has been able to find pipe line connections for practically all of the wells needing outlets. All of the purchasing companies are at the saturation point and it will be difficult to find additional connections for new wells.

Hobbs Field Has Produced More Than 25 Million Barrels

The Hobbs field of Southeast New Mexico has produced a total production of 25,034,213 barrels since its discovery to June 15, 1932. Shell Petroleum Corporation leads with a recovery of 3,406,121 barrels. If petroleum engineers are correct in their estimates of the ultimate yield of the field, approximately one-fourth of the oil has been taken out of the ground.

Proration Statute Held Constitutional

In the opinion of a special three-judge court the application of E. Constantin and other operators for a temporary restraining order to prevent the Texas Railroad Commission from enforcing orders concerning allowable production of oil was denied.

The opinion pointed out that the plaintiff's interpretation as shown in the record suggested that "instead of an eye single to conserving waste, regulations have been enacted in a sweeping way as a part of a general program to restrict production in the state and that the absence of this singleness of purpose has induced a regulation, which while it does not have relation to prevention of waste is unnecessarily drastic in its limitation.

"The record, however, does no more than suggest this. We are without proof; we may not conjecture whether these orders are beyond necessity and that another plan for the field, bringing about rateable and reasonable withdrawals of a considerably larger amount of oil per well, or upon the basis of potential rather than per well, would accomplish the permissible purpose without trenching upon the unpermissable one."

Seek Better Defense Against Tank Fires

A more general use of safe methods for protecting oil tank steamers and oil burning steamers against the ravages of fire and explosions is being sought by representatives of the National Board of Fire Underwriters, the National Fire Protective Association, the American Petroleum Institute, and other agencies who attended a session of the Conference Committee on Oil Fuels and Cargo late in July.

Natural Gasoline Production

According to the annual petroleum statement of the United States Bureau of Mines* the output of natural gasoline in 1931 totaled 1,831,900,000 gallons, a decrease of 17 per cent from 1930. Except for the Kettleman Hills and Oklahoma City, all the major districts produced less natural gasoline in 1931. This general decline resulted primarily from the severe curtailment in drilling with the only active area, East Texas, being notably deficient as to gas. Total stocks of natural gasoline, the major portion of which is held at refineries, declined from 3,100,000 barrels on January 1 to 2,818,000 barrels on December 31.

United States' Production of Natural Gasoline
(Millions of Gallons)

Field	1931	1930
Appalachin	72.5	89.2
Kentucky, Illinois and Indiana	10.5	13.5
Oklahoma	454.9	591.2
Kansas	32.7	35.1
Texas	426.7	491.3
Louisiana	58.0	73.7
Arkansas	26.3	30.6
Rocky Mountain	70.0	56.2
California	680.3	829.7
Total United States	1,831.9	2,210.5
Daily Average	5.0	6.1

The world production of natural gasoline, according to the United States Bureau of Mines, totaled 49,877,000 barrels during 1931, a decrease of 9,234,000 barrels, or 15.6 per cent from the record total of 59,111,000 barrels reported for 1930. The decline in world production resulted from the drop of 9,665,000 barrels, or 18.4 per cent, in the output of plants in the United States. The production in foreign countries increased from 6,481,000 barrels in 1930 to 6,911,000 barrels in 1931, a gain of 6.6 per cent.

World Production of Natural Gasoline

	1931	1930
United States	42,966,000	52,630,000
Netherland East Indies	1,580,000	1,786,540
Rumania	1,197,171	862,940
U. S. S. R.	750,500	532,000
Peru	728,207	771,890
Persia	673,122	677,800
Columbia	419,884	391,170
Poland	389,310	365,690
Venezuela	377,980	414,156
Argentina	190,401	170,428
Mexico	161,081	171,201
Japan	90,000	85,682
British India	86,000	89,720
Trinidad	85,876	6,026
British Borneo	78,030	82,830
Taiwan	50,000	46,062
Egypt	49,010	26,400
Ecuador	3,625	----
Total	49,876,707	59,111,344
Per Cent, U. S. A.	86.1	89.0

*July 15, 1932.

Latest Activities in th

Figures on maps indicate average prices paid for oil in adjacent fields

By WARREN

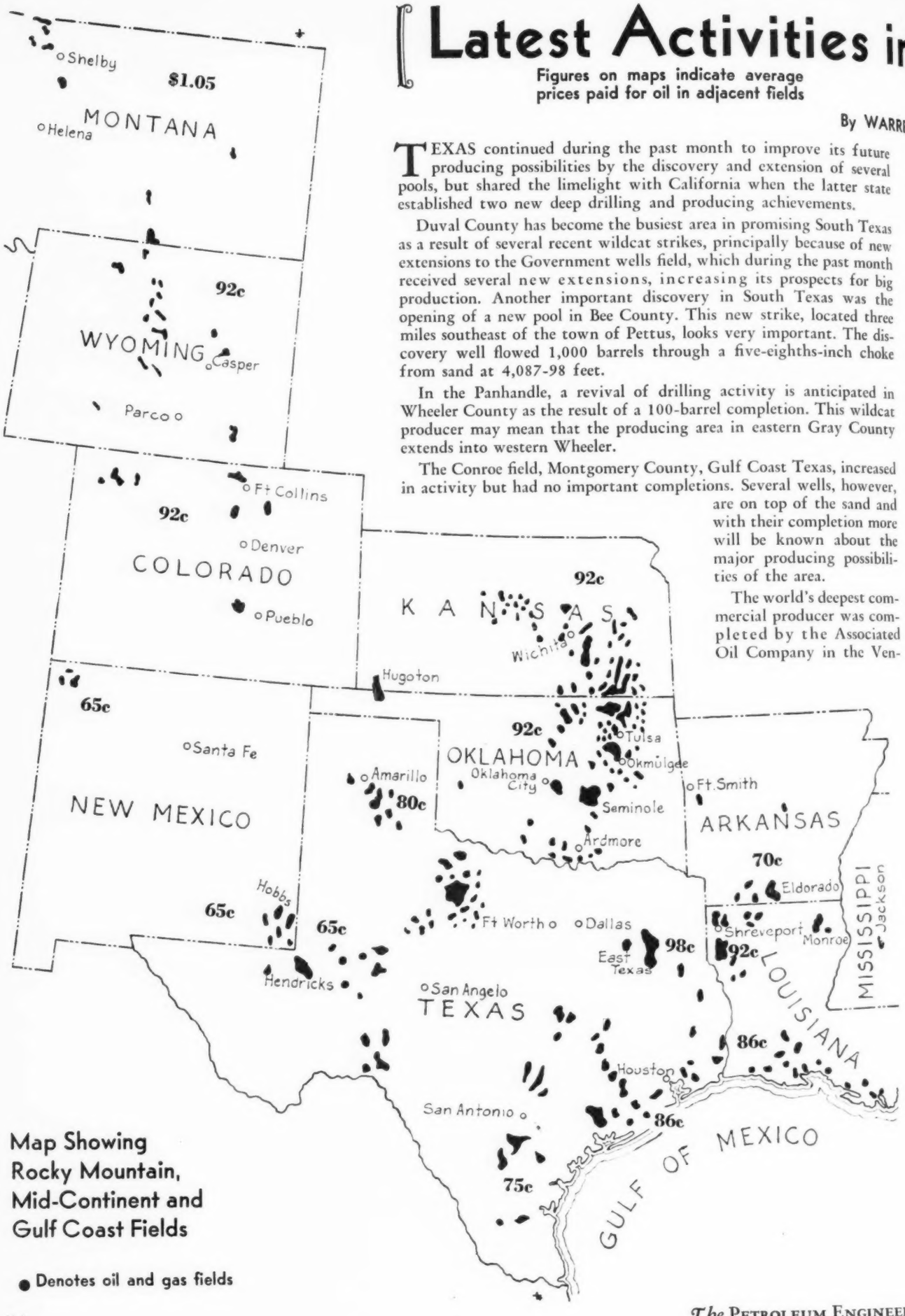
TEXAS continued during the past month to improve its future producing possibilities by the discovery and extension of several pools, but shared the limelight with California when the latter state established two new deep drilling and producing achievements.

Duval County has become the busiest area in promising South Texas as a result of several recent wildcat strikes, principally because of new extensions to the Government wells field, which during the past month received several new extensions, increasing its prospects for big production. Another important discovery in South Texas was the opening of a new pool in Bee County. This new strike, located three miles southeast of the town of Pettus, looks very important. The discovery well flowed 1,000 barrels through a five-eighths-inch choke from sand at 4,087-98 feet.

In the Panhandle, a revival of drilling activity is anticipated in Wheeler County as the result of a 100-barrel completion. This wildcat producer may mean that the producing area in eastern Gray County extends into western Wheeler.

The Conroe field, Montgomery County, Gulf Coast Texas, increased in activity but had no important completions. Several wells, however, are on top of the sand and with their completion more will be known about the major producing possibilities of the area.

The world's deepest commercial producer was completed by the Associated Oil Company in the Ven-



Map Showing Rocky Mountain, Mid-Continent and Gulf Coast Fields

● Denotes oil and gas fields

the Oil Fields

Figures giving production of individual fields will be found on page 9

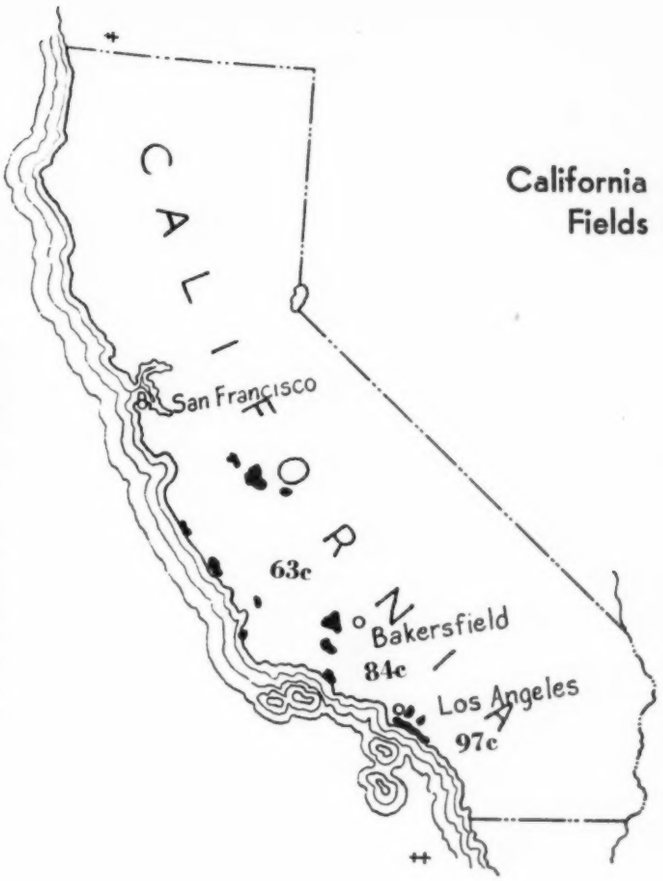
L. BAKER

tura Avenue, California, field. The well had an initial flow of 5,000 barrels from a depth of 9,700 feet. The company is now having the well killed so that it may be properly cleaned out. It is believed that its production will be materially benefitted by the cleaning out operations.

A new deep drilling record for the United States was established last month when Western Gulf Oil Company's Bradley No. 1, near Santa Maria, California, reached a depth of 10,294 feet, which is slightly more than 200 feet deeper than the previous record holder, but still short of the Mexican well, which penetrated to 10,585 feet. The Western Gulf well is now held up with a fishing job.

Several interesting developments were found among the wildcat tests operating in the Ellsworth Arch district, Kansas. The most important was the extension of production one-half mile and the finding of the second producing horizon in Northwest Kingman County. The Ellsworth Arch area is being closely watched because of the tremendous acreage included within the producing territory, but present indications are that it will amount to a series of pools rather than one gigantic field.

The Zwolle field of Western Louisiana continues to remain quite active. At the present time the area has 29 locations, 24 rigs and 32 drilling wells. The region is quite spotted, but each time it appears to be defined a producer is usually found within the supposed condemned sector.



California Fields

East Central and Eastern Fields

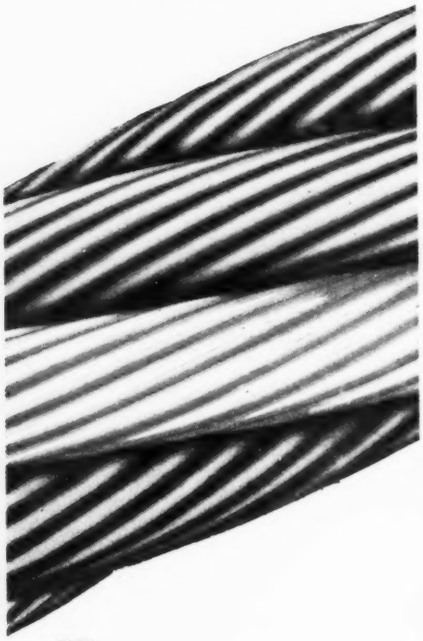
FACTORIES
St. Louis Seattle
BRANCHES AND WAREHOUSES
Seattle New York Portland
Los Angeles San Francisco
Houston
DISTRIBUTORS
In All Oil Fields

114 SELECTED WIRES

You don't think of the 114 wires in a 6x19 Yellow Strand Rotary Drilling Line as "individuals" do you? We do—we *must.*

That is why we have all wire for Yellow Strand Rotary Lines drawn to our own specifications from Swedish stock of supreme quality. This superior wire then receives a series of most grilling tests in our own laboratory.

Finally, we carefully select and group together those wires which our tests and our long experience indicate will produce the proper balance of elasticity, flexibility, toughness and tensile strength that will result in the longest possible life and economy. In



QIRI

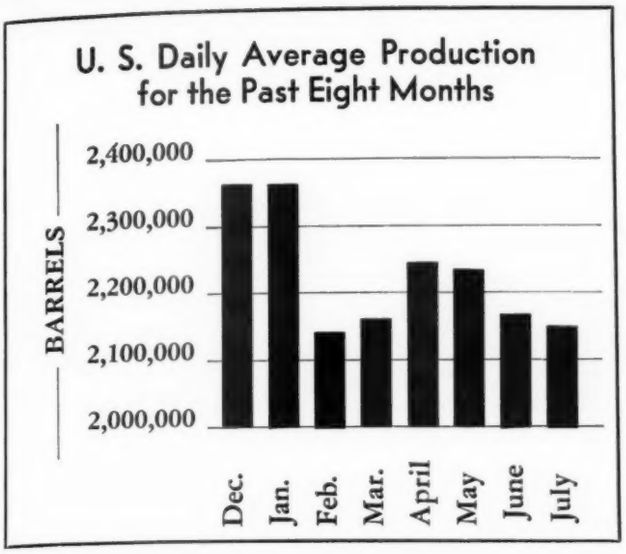
"Flex-Set" Preformed Yellow Strand Rotary Line

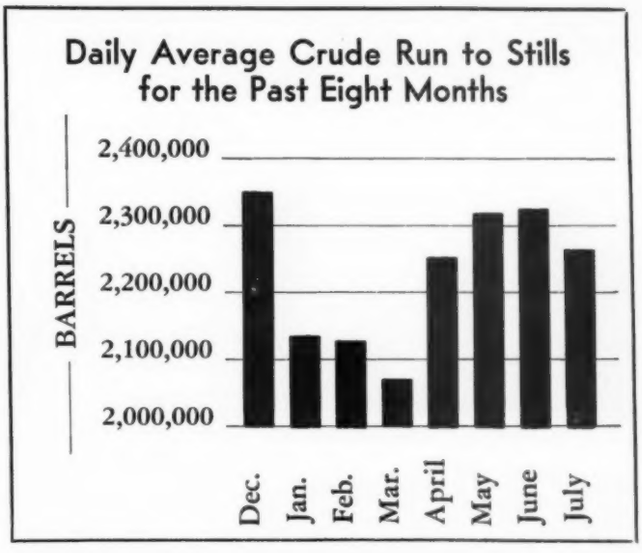
we go even farther. By preforming the wire and strands we eliminate internal stress. This makes the line easier to handle, easier to install, easier to operate, and greatly increases its operating life. Try "Flex-Set" Preformed Yellow Strand on your rotary rig for rockbottom economy.

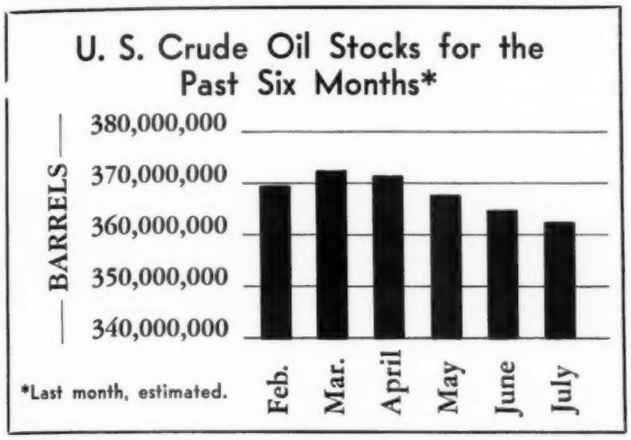
Write for Catalog 53

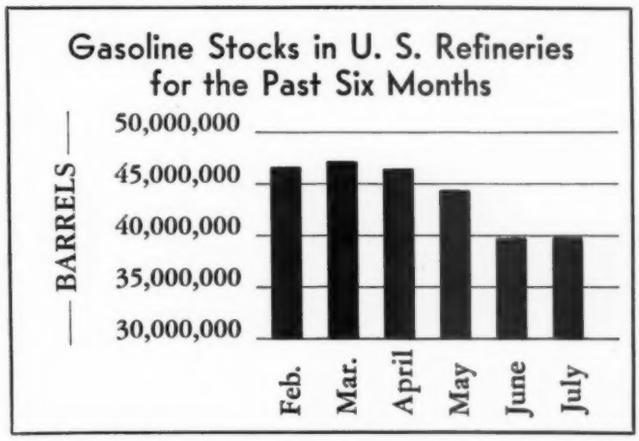
Broderick & Bascom Rope Company
ST. LOUIS, MO.

Yellow Strand Rotary Drilling Lines









Summarized Operations in Active Fields for July, 1932

Fields	Completions	Producers	Locations	Rigs	Drilling Wells	Depth of Production	No Casing Strings	Gravity of Oil	Type of Tool Used
Texas									
East Texas	591	589	556	253	369	3600	2	40	Rotary
Duval County	15	11	13	10	17	2300	2	22	Rotary
Panhandle	12	9	11	8	39	2900	2	40	Rotary
Conroe	1	1	4	3	12	5200	2	38	Rotary
Oklahoma									
Oklahoma City	10	10	3	32	41	6500	3	39	Rotary
Kansas									
McPherson	4	3	10	15	47	2900-3400	2	38	Rot.-Cab.
Ellsworth	8	8	6	5	26	3300	4	37	Cable
California									
Kettleman Hills	3	3	2	2	12	8300	3 or 4	60	Rotary
Long Beach	10	6	1	1	4	7000	3	26	Rotary

Field Activities by States for July, 1932

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1931 (in Barrels)
	July	June	July	June	July	June	July	June	July	June	
Arkansas	4	9	0	0	1	1	5	5	20	22	15,425,000
California	41	24	29	17	13	22	16	19	115	141	188,575,000
Colorado	1	5	1	1	2	1	7	9	64	63	1,510,000
Illinois	4	2	1	2	....	....	2	1	17	19	4,850,000
Indiana	9	20	5	11	....	....	4	4	60	59	830,000
Kansas	58	51	44	34	68	83	53	50	140	125	37,950,000
Kentucky	39	49	30	30	....	....	11	9	71	69	6,490,000
Louisiana	43	53	22	23	45	59	34	39	85	89	22,325,000
Michigan	9	13	7	9	....	....	39	41	73	75	3,730,000
Mississippi	0	6	0	3	1	4	3	2	14	14	Gas Prod.
Montana	2	1	1	1	....	....	6	5	14	15	2,855,000
New Mexico	4	4	4	4	....	....	7	9	49	46	15,250,000
New York	7	14	7	13	....	....	4	2	18	17	3,400,000
Ohio	44	67	31	47	....	....	28	30	105	109	5,315,000
Oklahoma	71	114	51	82	88	130	99	96	227	220	177,750,000
Pennsylvania	47	55	40	53	....	....	13	17	84	85	11,225,000
Tennessee	0	0	0	0	....	....	0	0	13	13	8,000
Texas	889	1,163	747	992	850	1,225	463	471	940	948	330,720,000
West Virginia	17	28	16	23	....	....	12	17	39	38	4,480,000
Wyoming	1	2	0	1	....	....	14	14	62	62	14,725,000
Total	1,290	1,680	1,036	1,346	1,068	1,530	820	850	2,210	2,266	847,413,000

Progress of Major Pipe Line Work

By J. H. DAMERON

COMPLETION of the Southern Counties Gas Company's 12-inch electric welded line to San Diego, Calif., brings to a close the only main line gas transmission system extension work of any magnitude for the summer. This new line originates at the Southern Counties Company's Long Beach terminal and follows a southerly direction to connect with the system supplying gas to San Diego. San Diego is at present being supplied with manufactured gas and the change over is to be made following completion of line tests.

In other sections of the country gas transmission companies are nearing the end of their re-conditioning and repair programs started late in the spring. Those companies building short extensions to their main lines and laterals to new towns have about completed all of their work and will be ready to render service to the new connections within a short time.

A normal amount of new work for gas systems at this time of the year is reported. In the eastern section interest has been revived for extensions to new towns in Illinois, Michigan and New York. A Public Service Commission ruling in the latter state has given impetus to extension work in New York. That ruling establishes the right of gas companies to charge consumers on the thermal unit basis instead of the number of cubic feet consumed, which permits the natural gas companies to capitalize on the greater heating efficiency of natural gas.

As a result of this decision the Lycoming Natural Gas Corporation will complete, late this summer, its line on into Syracuse. It had previously built 100 miles of 20-inch from the Tioga field to the Syracuse County line and only a short section remains open between Syracuse and the county line. It is rumored the company plans further extension in New York. The Lycoming Company is reported planning building a 40-mile 18- or 20-inch line from Tioga County gas field to the Potter County gas field in Northern Pennsylvania.

More activity is reported in the Illinois area on the part of transmission companies in their efforts to secure additional franchises. Right-of-way troubles have been one of the greatest stumbling blocks in the way of main line expansion in that general area. Efforts on the part of various interests to obtain a franchise in Detroit are being re-doubled with one company making an extensive survey to determine the feasibility of building a 20-inch line from the Michigan fields.

Reports are being circulated that the Standard Oil Company of Kansas has placed an order for 150 miles of eight-inch line pipe. However, no definite announcement has been made since the company announced some time ago that construction plans were being held in abeyance. The proposed line would extend to the newer fields in the western part of the Sunflower state.

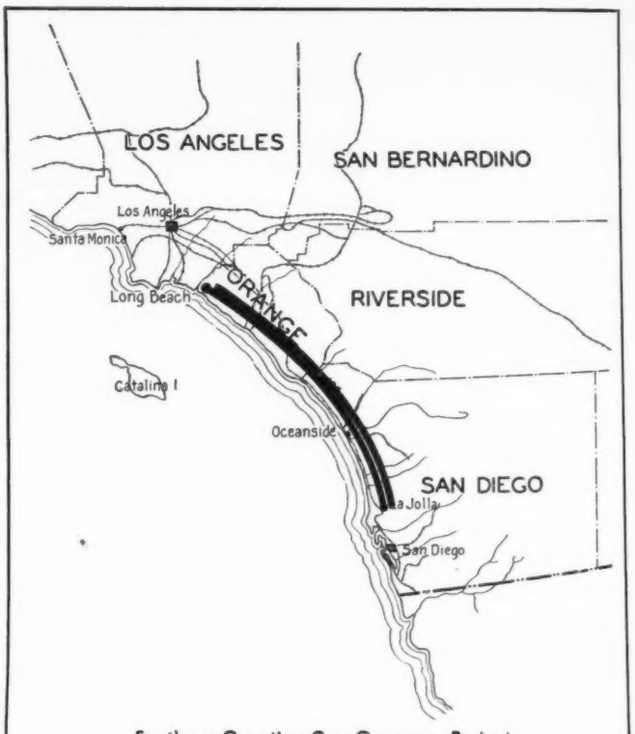
In southern Louisiana the Texas Pipe Line is building a 45-mile combination four-inch and six-inch oil line from Port Barre, near Opelousas, La., to Anchorage, on the Mississippi. The line is being built by the Apex Construction Company (Williams Bros. subsidiary) and consists of 25 miles of four-inch and 20 miles of six-inch. The entire line will be rubber ring type coupled. One station will be erected at Port Barre and oil will be delivered at the river terminal where it will be loaded in tankers.

The Humble Pipe Line Company has completed its eight-inch line from the new Conroe field to its main line coming down from North Texas and has the line in operation.

In Oklahoma the Champlin Oil Refining Company's pipe line department will increase the capacity of the company's Oklahoma City-Enid eight-inch line by building booster stations. It is reported the company plans to build four motor-driven centrifugal pump stations to increase the line capacity to 30,000 barrels daily.

The Illinois Pipe Line Company is building seven miles of six-inch welded line from its main line coming into Fort Worth from Ranger to the Marathon refinery at Fort Worth. The line construction is being spread out to give the maximum amount of labor to unemployed in Fort Worth.

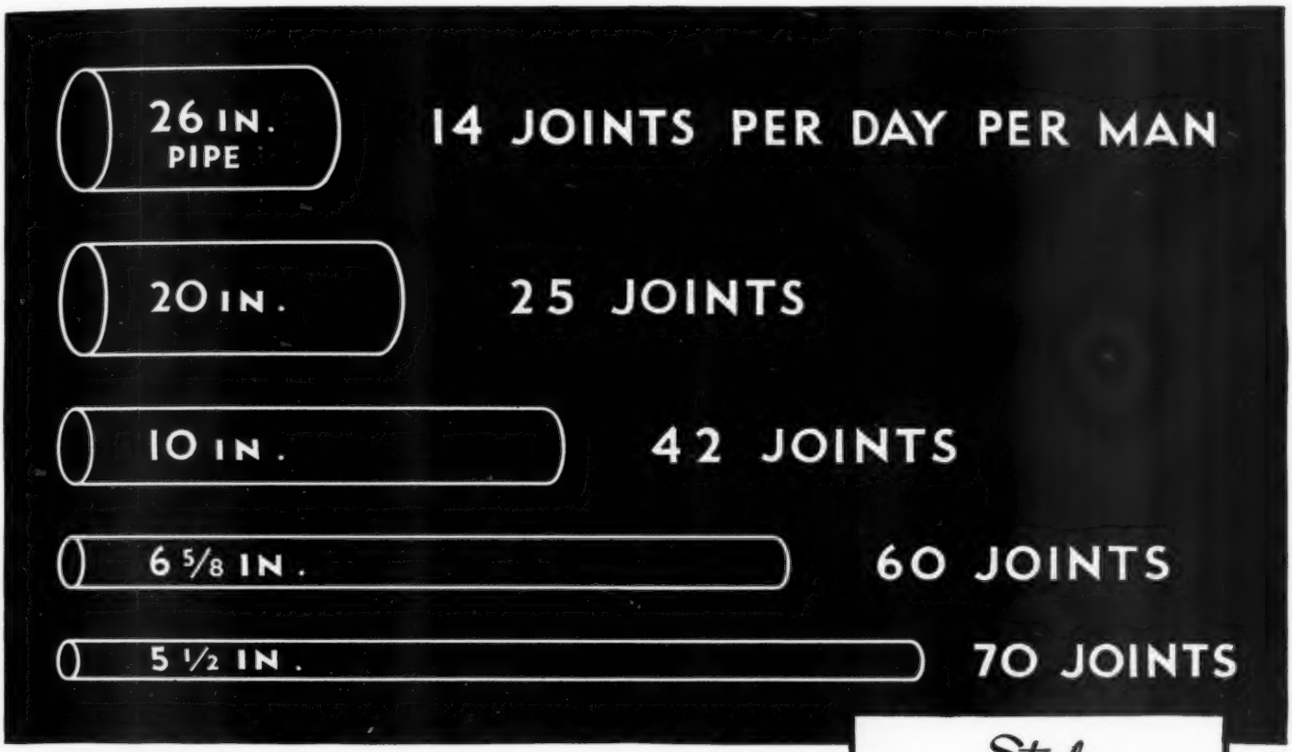
Despite the fact the A. G. A. report of 413 companies representing 90 per cent of all public utility distribution of gas for the first five months of this year showed a 7.1 per cent decline in comparison with the same period last year, gas companies are expecting an improvement for the latter part of the year. The re-opening of numerous industrial plants throughout the Nation is expected to materially improve gas company earnings.



Southern Counties Gas Company Project

THESE 5 JOBS

prove Lindewelding is faster—



THIS chart shows the average number of joints per day produced by each welder on five new Lindewelded lines.

It reflects the 30 to 60 per cent saving in time which Lindewelding makes possible.

Lindewelding is a new and better method of oxy-acetylene welding. It makes stronger joints with 35 to 40 per cent less material. It increases the speed of experienced welders and can be learned efficiently by beginners in a shorter time.

Procedure controls for Lindewelding are available to all users of Linde Oxygen. Write to the nearest Linde district office for complete information today.

Study Lindewelding Technique in this Motion Picture

The new motion picture, "The Lindeweld Process for Pipe Line Construction," shows every detail of Lindewelding technique, which differs from neutral-flame welding technique in that it employs a special rod, a special flame adjustment, and the "backhand" method of blowpipe manipulation. Pipe line officials and welding or engineering societies may borrow this picture free of charge by writing to any Linde District Office. It is furnished in 16 mm. and 35 mm. safety film.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

126 Producing Plants — UCC — 627 Warehouse Stocks

IN CANADA, DOMINION OXYGEN COMPANY, LTD., TORONTO

District Offices

Atlanta	Detroit	New York
Baltimore	El Paso	Philadelphia
Birmingham	Houston	Pittsburgh
Boston	Indianapolis	St. Louis
Buffalo	Kansas City	Salt Lake City
Chicago	Los Angeles	San Francisco
Cleveland	Milwaukee	Seattle
Denver	Minneapolis	Tulsa

LINDE OXYGEN · PREST-O-LITE ACETYLENE · OXWELD APPARATUS AND SUPPLIES · UNION CARBIDE

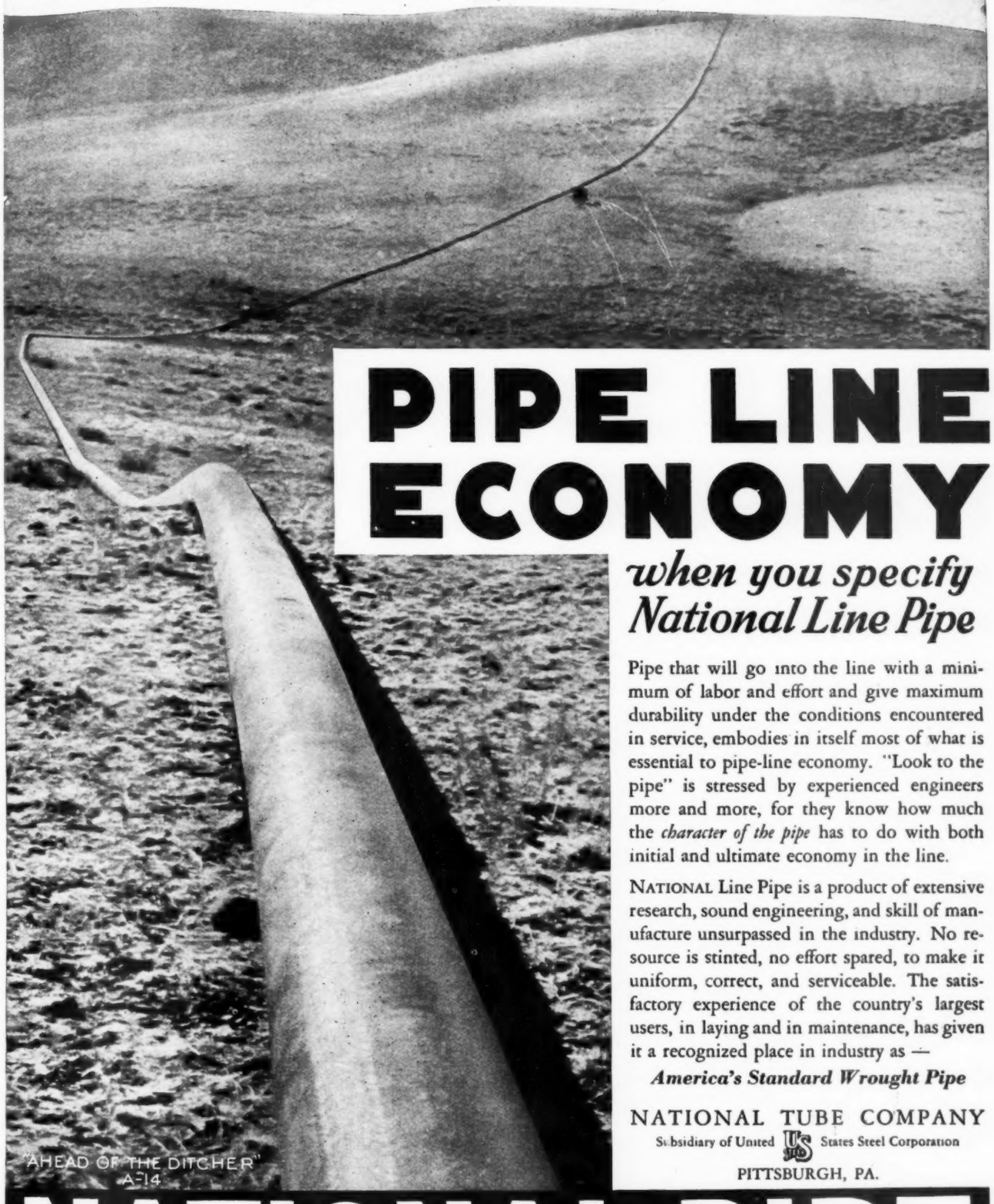
PIPE LINES UNDER CONSTRUCTION AND CONTEMPLATED

Type Line	Company Name	Headquarters	Point of Origin	Terminal	Size Pipe	Length in Miles	Remarks
G. L.	Bivens, C. E., et al.	Laramie, Wyo.	Baggs Field	Laramie, Wyo.	12"	104	Plan to build in 1932. Granted extension of time.
O. L.	Champlin Oil Refg. Co.	Enid, Okla.	(See Remarks)				Plan to build four booster stations on Oklahoma City-Enid 8-inch line.
G. L.	Columbia Gas & Elec. Co.	New York, N. Y.	Ky. or Pan Eastern Line	Detroit, Mich.	20"	220	Considering going to Detroit, Mich., with line and to Toledo.
G. L.	Continental Constr. Corp.	Chicago, Ill.	Chicago, Ill.	Detroit, Mich.	20"	200	Plan extension of Panhandle line to Detroit.
G. L.	Continental Constr. Corp.	Chicago, Ill.	Point in Ill.	Wilwaukee, Wis.	20"	160	Under advisement.
G. L.	Cities Service, Insull, Texas Corp. & S. O. N. J.	(See Remarks)					Rumored considering building 1,500-mile project from Panhandle to Eastern cities.
G. L.	Golston, Roy D.	Tyler, Tex.	Brownwood, Tex.	Lampasas, Tex.			Considering building gas line.
Ga.L.	Great Lake Pipe Line Co.	Kansas City, Mo.	Okla. Midcontinent	Great Lakes Region	4-6-8"	1440	Considering increasing station capacity.
G. L.	Great Northern Gas & Utilities Co.	Minneapolis, Minn.	(See Remarks)				Planning gas line from Baker-Glendive area in Montana to Minneapolis and St. Paul.
O. L.	Humble Pipe Line Co.	Houston, Texas	Conroe, Main Line		8"	28	Work half complete.
O. L.	Illinois Pipe Line Co.	Fort Worth, Tex.	(See Remarks)				Building 7-Mile 6-inch line from main line to Fort Worth refinery.
G. L.	International Util. Corp.	New York, N. Y.	Alberta, Canada	Vancouver, B. C.	20"	500	Proposed
G. L.	Kentucky Public Service Co.	(See Remarks)					Posted bond to build short line from Hart County, Ky., to Bardstown, Ky.
G. L.	Jerome Drumheller	Spokane, Wash.	Cut Bank, Wyo.	Seattle, Wash.	20"	500	Proposed.
G. L.	Lycoming Nat. Gas. Corp.	New York, N. Y.	Tioga Field, N. Y.	Syracuse, N. Y.			To build short line from Syracuse County line to Syracuse.
G. L.	Lycoming Nat. Gas Corp.	New York, N. Y.	Tioaga Field	Potter County Field	20"	40	Plan to build soon.
G. L.	Lewiston Nat. Gas Co.	Lewiston, Mont.	Armells Structure, Mont.	Montana Towns	4-6"	100	Proposed.
G. L.	Missouri Valley P. L. Co.	Omaha, Neb.	Point in Minnesota	Minneapolis, Minn.	16"		Proposed along with extension work in Iowa.
G. L.	Montana-Dakota Power Co.	Minneapolis, Minn.	Williams, N. D.	Minot, N. D.	12"	100	Applied to N. D. Commission for permission to build.
G. L.	Mo.-Kans. Pipe Line Co.	Chicago, Ill.	Russellville, Ky.	Nashville, Tenn.	10"	50	Proposed.
G. L.	North Central Gas Co.	Casper, Wyo.	(See Remarks)				Reported planning 100 miles of extension work in Nebraska and near-by territory. Part of work underway.
O. L.	Old Dutch Refining Co.	Muskegon, Mich.	East Michigan Fields	Muskegon	4"	100	Plans in abeyance.
G. L.	Ohio Oil Company	Findlay, Ohio	Weiser Field, Idaho	Boise and Northwest Area			Filed application for conveyance certificate.
G. L.	Pacific Gas & Elec. Co.	San Francisco, Calif.					Have appro. for $2,000,000 expansion campaign. Building 45 miles of 26-inch.
G. L.	Panhandle Eastern P. L. Co.	Kansas City, Mo.	(See Remarks)				Completed lateral line construction.
O. L.	Presidio Petroleum Co., Ltd.	Los Angeles, Calif.	Midland, Tex.	Topolobampo	10"	640	Propose to build to Mexican Port and erect two refineries, one at Chihuahua for domestic trade and the other at tidewater for export trade. Plan to parallel oil line with gas line to Chihuahua. J. F. Sadler promoting.
G. L.	Peninsular Pipe Line Construction Co.	Detroit, Mich.	(See Remarks)				Reported planning building 160-mile line from Mt. Pleasant field in Mich. to Detroit.
O. L.	San Juan Pipe Line Co.	Los Angeles, Calif.	San Juan County, Utah	Farmington, N. M.	8"	92	Reported planning to build this summer. Line will have three stations.
G. L.	Santa Maria Gas Co.	Santa Maria, Cal.	Santa Maria	San Ruis, Obispo	8"	21	Under construction.
	Standard Oil Co., of Kansas		(See Remarks)				Plan to build 150 miles 8-inch into western Kansas.
G. L.	Southern Counties Gas Co.	Los Angeles, Calif.	Huntington Beach	La Jolla	12"	68	To supply gas to San Diego. Complete.
O. L.	Texas Pipe Line Co.	Houston, Texas	Port Barre, La.	Mississippi Terminal	486"	46	Coupled line being built by Apex Const. Co.
G. L.	Wasatch Gas Company	Ogden, Utah	Ogden, Utah	Pocatello, Idaho	10"	140	Applied for permit to build welded line.

TABLE

O L.—oil line
G. L.—gas line
Ga. L.—gasoline line

You adopt the first step to



PIPE LINE ECONOMY

when you specify National Line Pipe

Pipe that will go into the line with a minimum of labor and effort and give maximum durability under the conditions encountered in service, embodies in itself most of what is essential to pipe-line economy. "Look to the pipe" is stressed by experienced engineers more and more, for they know how much the *character of the pipe* has to do with both initial and ultimate economy in the line.

NATIONAL Line Pipe is a product of extensive research, sound engineering, and skill of manufacture unsurpassed in the industry. No resource is stinted, no effort spared, to make it uniform, correct, and serviceable. The satisfactory experience of the country's largest users, in laying and in maintenance, has given it a recognized place in industry as —

America's Standard Wrought Pipe

NATIONAL TUBE COMPANY
Subsidiary of United States Steel Corporation
PITTSBURGH, PA.

NATIONAL PIPE

The Month's Activities in Refining*

By F. R. STALEY

REFINERS in the western division increased crude runs over the previous month; the others show a decrease.

The Alco Products, Inc., has completed an agreement to assume the management and engineering development of the Gyro Precess, together with the sale of licenses.

The Administracion Nacional de Combustible, at Montevideo, Uruguay, is planning the construction of a refinery with a capacity of 450 cubic metres of crude oil per day.

The Petroleum Distillation Corporation has been organized to act as agent for the licensing rights of fractional distillation patents owned by The Atlantic Refining Company, Standard Oil Company of Indiana, Standard Oil Company of New Jersey, and The Foster Wheeler Corporation.

The Globe Oil & Refining Company has completed plans for the construction of a 10,000-barrel refinery near McPherson, Kansas.

The Shell Oil Company of British Columbia, Ltd., will erect a modern refinery at Vancouver, Canada. C. E. Anstie is manager of the company. The first unit will process about 3,000 barrels of crude per day; this will later be increased to 10,000 barrels.

The Pure Oil Company is installing a new vapor recovery and stabilization plant in their Muskogee, Okla., refinery.

O. H. Schoenwald and G. M. Ford of the Wentz Oil Company, Ponca City, Okla., in coöperation with refinery of the U. S. Bureau of Mines, have developed a method of removing hydrogen sulphide from natural gas, based on the reaction of hydrogen sulphide with lime. The construction and operation of a commercial plant using the lime process is covered in detail by the Bureau's Report of Investigations 3178.

As a result of the duty imposed on gasoline imported to Canada a number of refineries have been erected during the past year. Several plants are under construction in Montreal East, and plans have been made for one in Vancouver and several in Ontario. Several existing plants will increase or install new cracking facilities.

The Wynnewood refinery of the Texas Pacific Coal & Oil Company was recently started up again in order to produce road oils and asphalts.

C. P. Ritter of Long Beach, Calif., plans the construction of a small refinery at Baca, N. M.

The Standard Oil Company of Indiana was awarded a contract for 699,500 gallons of road oils by the Wyoming State Highway Commission. Wyoming black crudes will be used in their manufacture.

The American Chemical Society will hold its summer meeting in Denver, August 22 to 26. A number of papers on petroleum subjects will be presented.

Natural Gasoline

The Magnolia Petroleum Company was granted a permit by the Texas Railroad Commission to operate a carbon black plant in Wheeler County. Proceedings of the Eleventh Annual Convention of the Natural Gasoline Association of America are now available, according to Ray E. Miller, secretary. The paper by Brown and Souders on the design of high pressure equipment is of interest to many engineers.

David E. Day will present a paper discussing the Lachman process before the California Natural Gasoline Association at its regular August meeting.

Figures in red show per cent refining capacity operated.

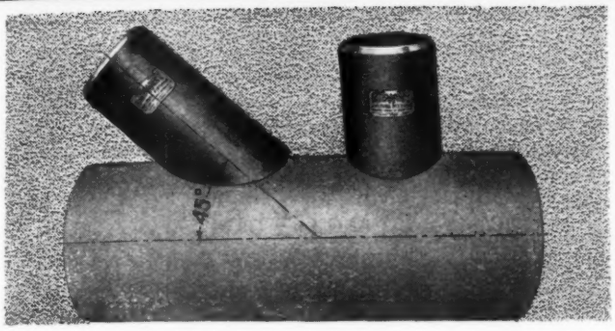
*All statistics as of August 1st.

ENGINEERS and contractors who are experienced with welded piping have been quick to recognize the advantages of the Midwest Welding Fittings shown here. It is not strange that many of these fittings were first offered to industry by Midwest—and that a number of them have highly desirable exclusive features. Midwest has been in the piping business for 27 years and has accumulated much experience in all its phases; Midwest was among the first to appreciate the possibilities of pipe welding and to use welding in its fabrications.

Midwest Fittings are probably the most complete line of welding fittings on the market today. There is a definite advantage in using one source of supply—in having the entire welded piping system of one high quality.

Space limitations make it impossible to here adequately describe each of the Midwest Welding Fittings. All the facts are given in Bulletin WF-10. Get a copy from the nearest Midwest office or distributor.

DESIGN AND REDUCE COSTS

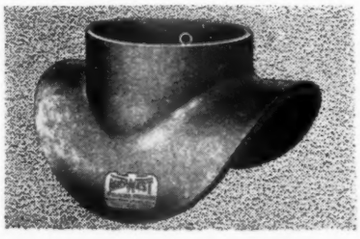


MIDWEST SHAPED WELDING NIPPLES

Eliminate all templates when saddling one pipe upon another; save time and assure accurate fit. Shaped and square ends both beveled for welding. Made from standard weight and extra heavy steel pipe and genuine wrought iron pipe; sizes 1¼" to 12". Provided with any lap or flange on special order, other angles also available.

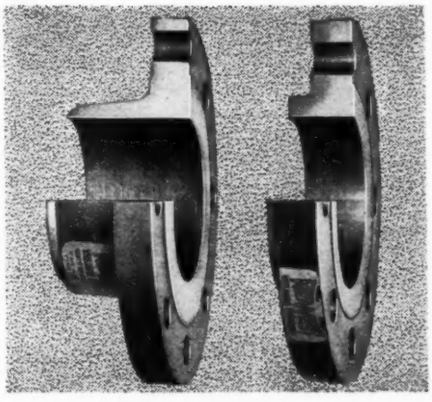
MIDWEST WELDING REDUCERS

Economical and efficient means of reducing from one pipe size to another. Uniform and easy taper minimizes the pressure drop. Tangents long enough for quick, accurate lining up with pipe; also for use of slip-on flanges. Ends beveled for welding. Made from standard weight and extra heavy wrought steel and genuine wrought iron; eccentric and concentric sizes 1" x ¾" to 12" x 5".



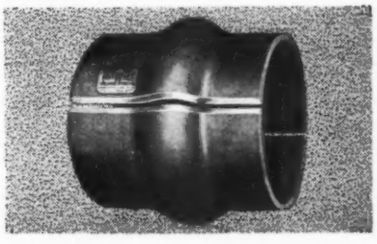
MIDWEST WELDING SADDLES

It not only reinforces the junction of neck and body of a welded header but also compensates for the weakening of header body that results from loss of the metal cut out for the neck opening. Tests proved this saddle materially increases the strength of a welded header over customary gusset plate construction. Made from flanging quality steel; sizes from 2" x 2" to 24" x 24".



MIDWEST WELDING FLANGES

The slip-on flange is slipped over end of pipe or Midwest Ell and then welded front and back. It is easier to line up than the butt welding flange which requires only one weld and saves pipe equal approximately to length of flange hub. Both flanges are forged from steel that welds easily and are accurately machined. Sizes include 24".



MIDWEST WELDING SLEEVES

Used to reinforce a butt line weld between two pieces of pipe, it relieves the butt weld of any bending stress and much of the tensile stress to which it would otherwise be subjected. Transverse recess in sleeve permits its application over the conventional butt line weld. Made from mild steel plate; sizes 4" to 24".

MIDWEST PIPING & SUPPLY COMPANY, INC.

Main Office: 1450 South Second St., St. Louis

Offices: Chicago, 208 South La Salle St. . . . . Houston, 600 Bringhurst St. . . . . Los Angeles, 520 Anderson St. . . . . New York (Ballwood Division), 30 Church St. . . . . Tulsa, 733 Mayo Building

DISTRIBUTORS

Baltimore, Md.	Southern Supply Co.	Durham, N. C.	Noland Co.	Raleigh, N. C.	Noland Co.
Charleston, W. Va.	Capital City Supply Co.	High Point, N. C.	Noland Co.	Richmond, Va.	Noland Co.
Chicago, Ill.	Himelblau, Agazim & Co.	Lynchburg, Va.	Noland Co.	Roanoke, Va.	Noland Co.
Cleveland, O.	Universal Valve & Fittings Co.	Newport News, Va.	Noland Co.	San Francisco, Calif.	Chas. S. James Co.
Conshohocken, Pa.	Ford & Kendig Co.	Norfolk, Va.	Noland Co.	Spartanburg, S. C.	Noland Co.
Detroit, Mich.	Coon-DeVisser Co.	Philadelphia, Pa.	Ford & Kendig Co.	Toledo, Ohio	Mason Equipment Co.
		Pittsburgh, Pa.	Chandler-Boyd Supply Co.	Washington, D. C.	Noland Co.
		Portland, Ore.	Harris Supply Co.	Winston-Salem, N. C.	Noland Co.

Gas Engines and Motor Power Stations Designed for Varying Loads

By J. H. DAMERON

PUMPING equipment in the Arkansas Pipe Line Company's stations on its Longview, Texas-Shreveport, La., 68-mile eight-inch welded oil carrier affords the transporting company a wide range of pumping capacities to meet economically the varying conditions of the system. The line delivers only East Texas crude to the company's Shreveport terminal for Shreveport refineries, and for shipments north and south. During a 30-day period the system may have a wide variation of deliveries, due primarily to proration, consequently a wide range of pumping conditions are met.

Caster station is the initial station on the line and is located near Longview. Thirty-two miles east of Caster is Midway station, equipped with two motor-driven centrifugal pumping units. The units in Caster station consist of two gas engine-driven reciprocating pumps and two motor-driven centrifugal units. When the line's full capacity is required, all units are in operation, working against a pressure of 900 pounds to deliver about 32,000 barrels of crude daily during summer months. For deliveries under maximum capacity a combination of units is placed in service to deliver the required volume.

Because of the station's close proximity to a large diameter gas transmission system gas engines were installed to drive the reciprocating pumps. Fuel gas cost is low and no fuel tanks or fuel oil system is required for the plant. A short lateral line was extended from the gas line to the station and all gas used for station fuel or use in the station cottages is measured through the meter on the lateral line.

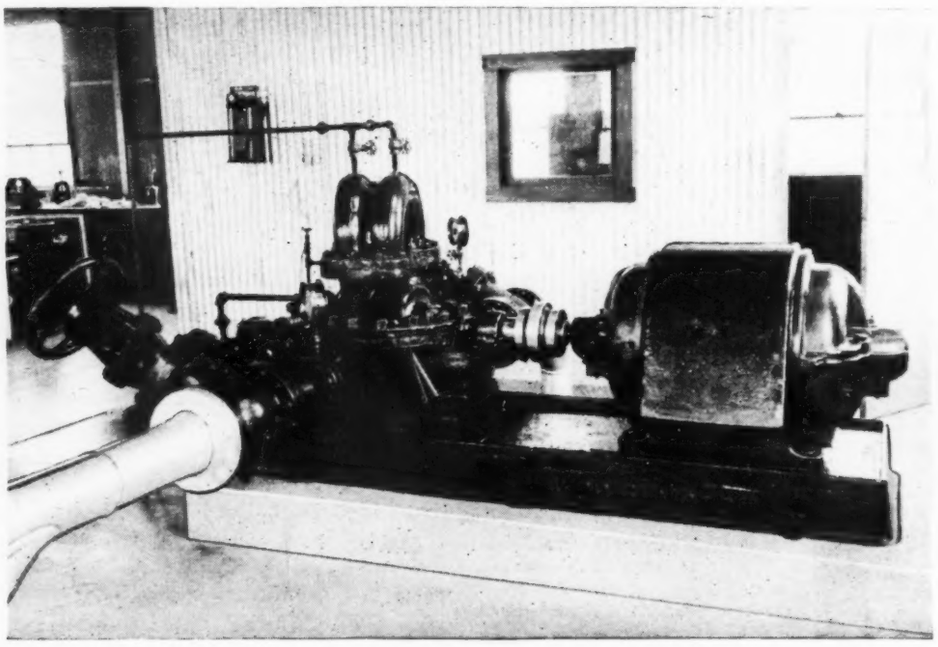
The gas engines are four-cylinder, four-cycle, 13½ by 15 bore and stroke vertical engines rated to develop 200 horsepower at 275 r.p.m. These units are connected to the pump shafts with large spring type resilient couplings designed to absorb the firing shocks. The pinion shaft for each reciprocating pump unit is supported by two pedestal bearings with sight feed lubrication.

Each engine is equipped with a gravity sight feed lubrication system for crank case oil which requires about one gallon of make-up oil every 24 hours. Force feed lubrication is used on the main bearings. Oil for the main bearings passes through a small filter before going to the oil pump and the pressure indicating gauges for the lube lines are located on the discharge lines of the lube oil pumps.

Both line pumps are 5x24 duplex reciprocating units and each pump discharge is equipped with an air bottle to relieve pump surges. Spring type indicating pressure gauges for each reciprocating pump discharge are located on the wall near the fluid end of the pump. Each gauge is equipped with an air cushion to reduce surge shocks in the gauge line. A recording gauge is used to obtain main line pressure.

Circulating water for the engines is obtained from a deep well that is flowed by air pressure supplied by a motor-driven air compressor. The water is stored in a concrete reservoir. A near-by stream is used as a reserve supply. Water is circulated by a 4¾ x 5 reciprocating pump, taking its suction from the reservoir, circulating through the jackets and returning the water to the sprays in the reservoir. The pump is connected to the engine stub shaft by means of "V" belt drive and insures the water pump starting when the engine is started.

Starting air for the engines and other purposes is stored in three shop-made welded air vessels located outside the building. A motor-driven air compressor is used to keep the tanks charged and a gasoline engine-driven compressor is used as a stand-by unit.



View of centrifugal pump unit

The two motor-driven centirfugal pumps at the station may be operated singly or in series. Each is a three-inch two-stage unit designed to deliver 380 g.p.m. against a head of 900 feet. Bearings are lubricated by the fluid being pumped, it first goes through a strainer on the high pressure side and drains into sump. The oil is returned from the sump to the pump suction, by means of a rotary sump pump.

Each motor is a 150-horsepower at 3500 r.p.m. induction type unit directly connected to its pump with a flexible coupling and mounted on the same base plate as the pump. All pump connections are made with fittings for welding. Mitre welds were made for the bends in the piping coming up from the conduits to the pump suction or discharge connections. Gates on both the pump suction and discharge are 1000-pound test valves. Electrical starting equipment is housed in a separate room in the building. This room has a window looking out towards the pumping units in order that the operator may observe the equipment as it is started.

The station is equipped to handle minor repairs but all difficult repairs are made at the company's shops in Shreveport. Small tools are racked on a wall board that is located conveniently to the work bench. The board is painted black and the outline of each tool on the board is painted white so operators may readily tell when anyone has failed to return tools to their proper places.

The building is a 150-ft. by 50-ft. bolted, sectional galvanized iron structure with steel girths and braces. All of the station piping is in conduits covered with steel gratings. Wiring is also in conduits and connectins for trouble lamps, etc., are spark-proof. Fire fighting equipment consists of hand operated extinguishers for both oil and electrical fires, a portable foam tank, and water lines.

Keeping the painted concrete floor in a neat condition proved difficult during the first year of the station's operation. Soil at the station site is sandy and the wind carries a certain amount of the gritty material to the station floor. Men walking in from the outside carried some sand in on their shoes and as they walked to various parts of the station the sand was ground into the paint, cutting it away. In order to keep the floor in a desirable condition it was necessary to paint it three times during the first year. This condition has been remedied considerably by landscaping the station grounds, and by sodding.

Caster station was designed without a standard type manifold. The 10-inch suction comes down from a tank farm, and extends along the outside wall the full length of the building. Each unit takes its suction from this line. Tanks are on an elevation high enough to permit ample suction line pressure. Control valves for the pumps are located in concrete boxes beneath the station floor. The valve wheels have a suitable length extension stem equipped with a box on the end to engage with the valve stem. To operate a valve, the attendant inserts the extension stem through a port in the grating, engages it with the valve stem and operates the valve. When not in use the extension stem is removed and stored.

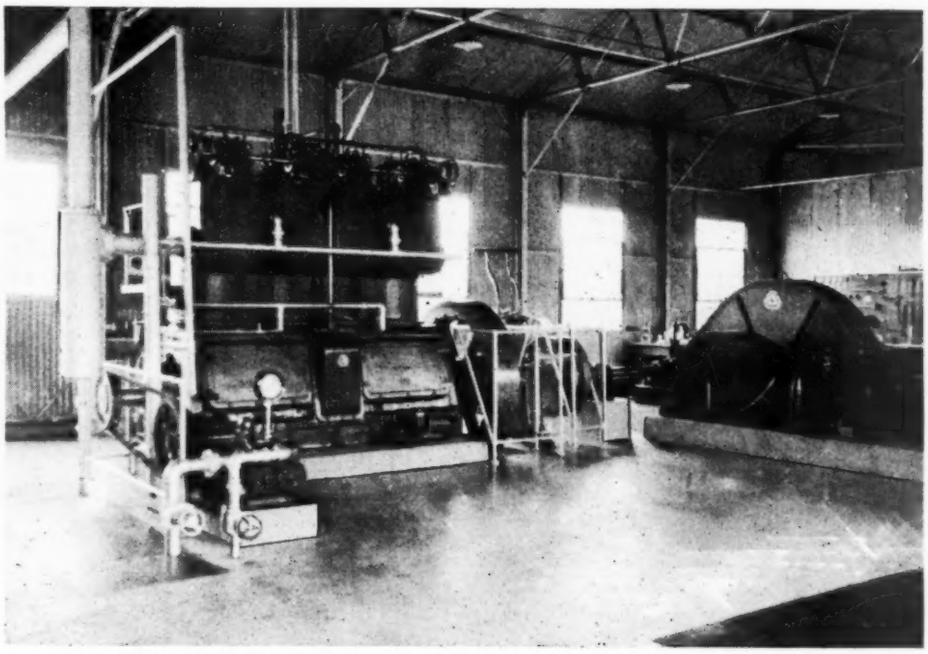
Two 55,000-barrel capacity steel tanks comprise the station storage. One is used as a receiving tank for the field lines and the other is a working tank for the station. All crude pumped first passes through the dual strainer on the suction line.

This strainer permits one side to be cleaned without interfering with station operation. At one time last year during a cold snap it was necessary to remove the working strainer every six hours to clean the collection of paraffin and gritty material.

The pipe line operates with crude gathered chiefly in the north end of the East Texas area. Lines for the gathering system are built with four types of joint construction.

A large part of the system was built with bolted sleeve type couplings. Rubber ring type couplings were also used. The remainder of the gathering system was built with both welded joints and screw couplings.

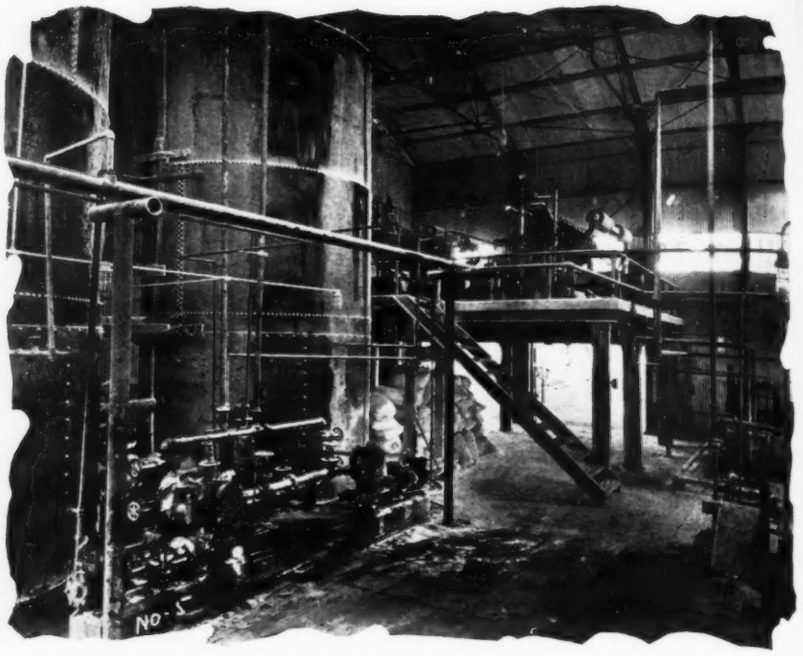
The main gravity lines have been built with eight-inch pipe, with four- and six-inch pipe used for laterals. All of the high pressure lines have been built with four-inch pipe.



Gas engine driving reciprocating pump

The Effects of Oxidation on Lubricating Oils

By H. B. BATCHELOR, M.Sc.
The Texas Pacific Coal & Oil Company



A LUBRICATING oil refined from a paraffin base crude and one refined from a mixed base crude were compared in order to determine the effects of oxidation on lubricating oils. Each of the oils was tested under the same conditions and in the same manner throughout the tests.

Air was used as the oxidizing agent, and was delivered at the bottom of the flask under the surface of the oil through a glass tube which had been drawn to a small nozzle. On the other end of the tube, which passed through the stopper, was placed a stop cock for adjusting the air supply in order to maintain a constant flow. The air was drawn through the oil by reducing the pressure slightly on a receiver at the end of the condenser. A larger tube was arranged in the flask so that samples of the oil could be drawn off at different intervals by increasing the pressure in the flasks slightly above atmospheric pressure.

The temperature of the oil was maintained between 275 and 300 degrees F. throughout the tests. A Tag Robinson colorimeter was used to determine the color of the oil. Those that showed a color below one-eighth were diluted with water white mineral oil. The color of the dilute oil was taken as additive. The other tests were run according to the United States Government Specifications.

Of the original samples the color of the mixed base oil was much lighter than that of the paraffin oil. As the oxidation proceeded the mixed base oil became blacker and blacker and finally lost all of its bloom, assuming an asphalt color. The paraffin base oil did not show as distinct a graduation in color. It finally lost its bloom in the last period of oxidation, but it did not become black as the other oil. It is evident that more of the asphaltic type substances were formed in the mixed base oil. It was substantiated also by the increase in sludge.

It may be seen that in the case of either oil there was a greater increase in organic acidity in the latter part of the tests than during the first few hours of oxidation. The mixed base oil showed about twice the increase in organic acidity over that of the paraffin base oil during this period.

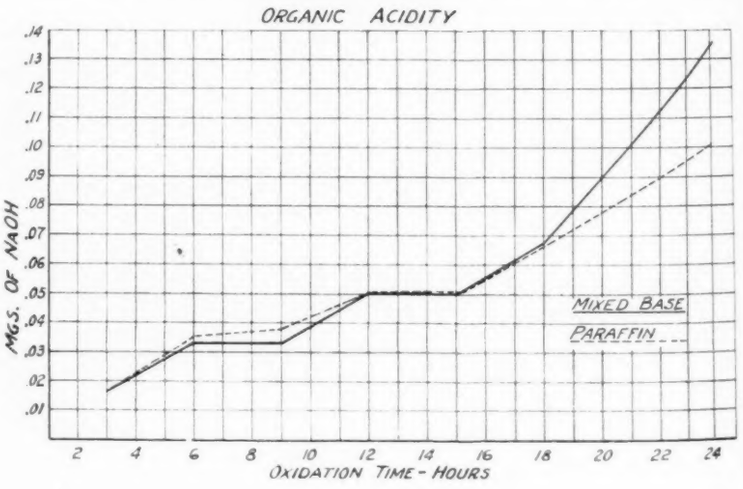
From these results it is demonstrated that lubricating oils refined from mixed base crudes are more susceptible to oxidation below 300 degrees F. than the lubricating oils refined from paraffin base crudes.

The increase in organic acidity in the oils causes one to expect a decrease in the coefficient of friction. Consequently a sample of the original oil and a sample of the same oil after being oxidized for six hours were run on a Herschel oiliness machine. The results showed a slight decrease in the coefficient of friction with a brass disc, or in other words, an increase in the property of oiliness. However, the difference was very slight. The reading for the coefficient of friction for the original sample was 0.152 and after six hours of oxidation it was 0.148.

DATA

Motor Oil Medium	Sayb. Uni. Viscosity 100°F.	Color Tag. Rob.	Sludge	mg of NaOH per gm of oil	Oxidation Temp.
MIXED BASE OIL					
Original Oil Sample.....	376	3¾	Trace	0.0165	275° to 300°F
After 24 hours of Oxidation..	396	1/12	0.05cc	0.1353	275° to 300°F
PARAFFIN BASE OIL					
Original Oil Sample.....	435	2	.....	0.010	275° to 300°F
After 24 hours of Oxidation..	445	3/8	Trace	0.1014	275° to 300°F

MIXED BASE OIL			PARAFFIN BASE OIL		
No. hrs. of Oxidation	Color Tag. Rob.	mg of NaOH per gm of oil	No. hrs. of Oxidation	Color Tag. Rob.	mg of NaOH per gm of oil
3	3⅛	0.0165	3	1¾	0.01618
6	1¾	0.0337	6	1¼	0.03504
9	1½	0.0335	9	¾	0.03758
12	1	0.0507	12	⅝	0.05073
15	½	0.0507	15	½	0.05073
18	⅜	0.0676	18	⅜+	0.06665
24	1/12	0.1353	24	⅜−	0.10137



Modern Equipment and Methods Used on World's Deepest Cable-Tool Hole

By WARREN L. BAKER

THE successful penetration to a depth of 9,104 feet by a cable tool test in Roane County, West Virginia, has demonstrated the possibilities of deep hole drilling with this type boring machinery. This well, the deepest cable-tool drilled hole in the world, reached its great depth without undue troubles, and only an explosion of unknown origin has prevented it from probably attaining an even greater footage mark. It belongs to the United Fuel Gas Company and is listed as well No. 4053 on the J. W. Hinzman farm.

The close following of a carefully planned, predetermined program was one of the practices adopted in connection with the drilling of the well that must be looked upon with much interest and be given considerable credit for the ability to reach a depth of more than 9000 feet. In planning the drilling program for the Hinzman test, the Company engineers studied each of the few tests that had previously drilled to 6000 feet, or more, in the eastern territory of the United States for the purpose of ascertaining, as nearly as possible, the probable causes of troubles in these wells. After these surveys were completed, they proceeded to investigate the size and weight of materials that might be best suited for their needs, and then such materials and machinery, all the latest type of modern cable tool equipment, were carefully selected. The success of the predetermined program is best indicated by the fact that all the equipment selected proved satisfactory and that, with only slight variations, the drilling program was carried out as planned.

The first consideration in the selection of suitable equipment for the well was the proposed depth of 9000 feet. Every piece of equipment was chosen because the company's engineers thought it would withstand the strain of reaching this depth and in handling the large quantities of casing that were to be set. Other factors considered were the character of formations to be penetrated, geographical location, quantity and quality of water available and the distance of the well site from railroads and good trucking roads.

All the equipment used was considerably heavier than the average cable tool equipment now in general use, and several new pieces of machinery were tried and tested.

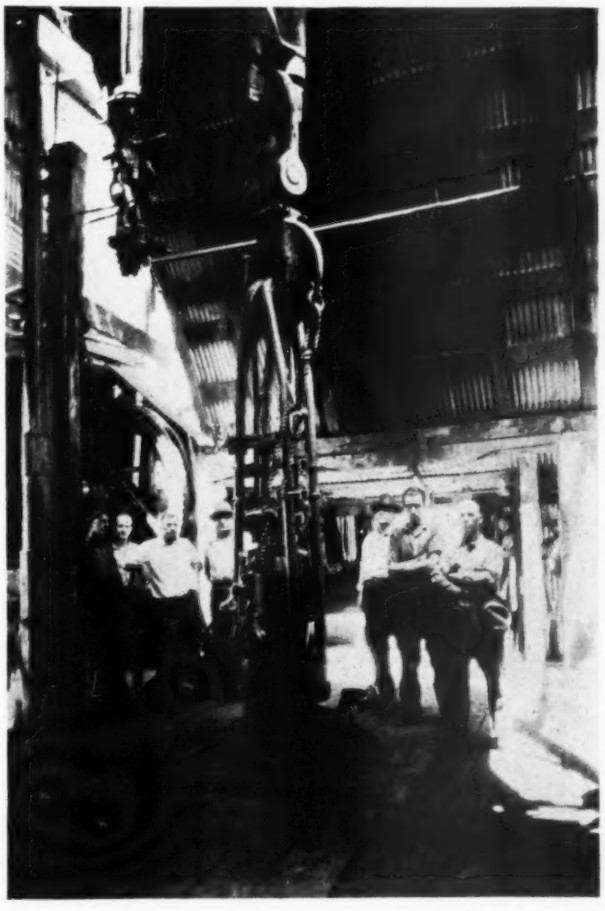
A new departure in drilling practice was the use of a combination wire line after a depth of 7500 feet had been reached. This combination wire line was composed of 4000 feet of 1⅛-inch diameter line and 6500 feet of one-inch diameter line, a long factory-made taper joint connecting the two. This Leschen line proved very satisfactory and was used from 7500 feet to the total depth of the hole. The combination line was adopted when a slight "drawing down" of the cable was noted at a point just below the wire line clamps. The 60-inch Crotto Monarch wire line clamps were extended by special plates to 72 inches to handle the long spool of line. They weighed 190 pounds and were equipped with 19-inch reversible slips.

After spudding was completed, drilling was begun with a seven-eighths-inch by 4000-foot Leschen wire line with 425 feet of 2½-inch manila rope as a cracker, six-inch tools, and a Crotty & Company bit dressed to 20 inches. The cracker was removed at 4000 feet, at which depth 7500 feet of one-inch line was substituted for the seven-eighths-inch one.

Owing to the unusual length of spool required for the wire line used, special attachments had to be made to the bull wheels and sand reel to accommodate the line. The bull wheels were eight feet in diameter with a 14-inch face, equipped with a wood-lined steel brake wheel at either end and the latest type improved brake irons and an eight-foot steel triple lug. This assembly had a heavy shaft 18 inches in diameter, 13½ feet long, with special gudgeons. The sand reel had 36-inch brakes and 48-inch flanges.

A new piece of equipment tried out on the test was a specially designed new hydraulic type of brake, which was placed on the Parkersburg sand reel at 5200 feet and on the bull wheels at 7500 feet. This new device proved very serviceable and valuable in subsequent drilling operations.

A most important item in deep cable-tool drilling is the casing string program, particularly the first or largest string, as it influences the number of probable lengths of each succeeding string. The casing program adopted for the Hinzman test was carefully followed in the actual work, as can be noticed from the accompanying chart, showing the casing plan. Several conditions encountered within the hole caused some variations in the actual program, as follows: The 10¾-inch was run early on account of dangerous cavings; due to the cementing of caves the eight-inch hole was carried to 6886 feet and required the use of the additional 6⅝-inch casing, but this saved a string of 4⅞-inch pipe.



Running 4,131 feet of 10¾-inch casing, weight 106 tons, on world's deepest cable tool test

The outstanding mechanical and engineering problem in drilling this deep well was encountered in running these casing strings. Six strings of National Tube Company casing with a total weight of 432 tons were successfully run, the longest of which was 6886 feet and the heaviest of which weighed more than 100 tons.

Due to the danger of caving, all these strings had to be run in a dry hole. It is believed that a new world's record was established for running such heavy long strings of casing in a dry hole, but due to the carefully planned and carried out program no difficulty was experienced. Heavy steel casing shoes were used on all strings; about one-half the tension was removed from each string, placing a large part of the load on the 16-inch Butler Automatic Casing Spider, which was equipped with slips for 16-inch, 13⅜-inch, 10¾-inch, 8⅝-inch, 6⅝-inch and 5 3/16-inch casing. This casing spider had a total weight of 3513 pounds.

Caves were cemented and successfully shut off in both the ten-inch and eight-inch holes, for which purpose more than 1500 sacks of Portland cement with 192 gallons of quick-set compound were used.

Because of the excessive weight of some of the casing strings considerable attention was devoted to the construction of a strong rig foundation, more than 100 cubic yards of concrete being used for the foundation and the enclosed pit, where the blocking and spiders to hold the casing were located. This foundation supported a special extra-heavy reinforced 87-ft. steel rig with a 24-ft. square base. This Parkersburg derrick had a safe working load of 398,000 pounds and was equipped with a seven sheave double bearing crown block assembly.

CASING DATA

Size	Length Set	Length Proposed	Weight Per Foot	Ton Weight Per String	Material
18⅝"	624′	600′	87.50	27.3	Lapweld
16"	1001′	1000′	84.00	42.0	Lapweld
13⅜"	1947′	2100′	68.00	66.2	Grade "C" Seamless
10¾"	4131′	4600′	51.30	106.0	Grade "D" Seamless
8⅝"	5221′	5200′	38.30	100.0	Grade "D" Seamless
6⅝"	6886′	6100′	26.20	90.2	Grade "D" Seamless
4⅞"		7600′			

Deepest well in the world drilled with cable tools

All the other rig equipment was likewise of heavy construction, such as would be needed for drilling so deep a test. The crank shaft assembly had a shaft six inches by eight and one-half feet, with a six-hole crank. The band wheel was 14 feet in diameter, with a 14-inch face steel wheel. A 14-inch by 115-ft., 10-ply belt was used. The Parkersburg pitman and walking beam were of steel, the beam weighing 100 pounds. The casing block, of Oil Well Supply Company design, was 66 inches, with steel sheaves 31 inches in diameter, and had a weight of 4752 pounds. The elevators used were one 21½-inch Butler Slip Ring and a similar make of 10¾-inch size. An Oil Well ball bearing eight-inch swivel hook, having a capacity of 150,000 pounds was used.

The prime mover was a 200-horsepower, twin-cylinder, Franklin Valveless gas engine. This outfit furnished ample power, as shown by the fact that the use of only one of the cylinders worked best for drilling operations, the second cylinder being 'cut-in' for the heavier work when pulling out, bailing or running casing. This engine was a heavy duty, slow speed 15 x 15, two-cycle, horizontal machine, weighing 20,500 pounds with the clutch.

Approximately one year had been spent in actual drilling operations on the test up to the date of the explosion. When the accident occurred 449 days had elapsed since the well was spudded; however, 18 days of that time was due to fishing job and 62 additional days were consumed in cementing operations, leaving 369 days of actual drilling time. At the present, the crew is attempting to fish out the material in the hole, lost when the explosion happened.

The hole has been perfectly straight and plumb, according to several tests made while drilling. Temperatures were taken by representatives of the U. S. Bureau of Mines to a depth of 6500 feet, at which point a temperature of 135 degrees F. was recorded.

The drilling of this well is one of the greatest cable tool achievements. The several departures made from regular cable tool practices are regarded by cable tool men as the most important advancements made in that phase of the industry in some time. The new type of equipment used is also another important step forward. That the equipment and methods employed were highly successful is best demonstrated by the ability of the equipment to withstand all the strain of running the various casing strings and in permitting drilling to continue to below the 9,000-foot mark.

Although production was not found in commercial quantities, it is not likely that hopes of finding production near 10,000 feet in the eastern portion of the United States will be abandoned. Previously, several gas wells have been found at depths around 7,000 feet in the district and several formations of possible oil-carrying ability have been found by these deep tests. The possibilities of deep production in the Eastern States is an important matter to the oil industry. Should it be found in good paying quantities, the result would probably be a redrilling and deepening campaign in many of the old producing areas.

Developments in Cracking Plant Equipment

By F. R. STALEY

A TOTAL of 176,437,000 barrels of cracked gasoline was produced in the United States during 1931,[1] this being an increase of 11,994,000 barrels over 1930. Of the total motor fuel production 40.3 per cent was manufactured by cracking in 1931 and 37.3 per cent in 1930. The percentage of cracked gasoline for this year will no doubt exceed all previous figures, due to the continuous expansion of cracking capacities, installed to manufacture high octane gasoline.

Manufacturers of cracking plant equipment are constantly improving their products through coöperation with refinery engineers. Metallurgists have developed alloy steels that withstand the severe operating conditions resulting from the combination of high temperature and pressure, together with the destructive action of corrosion and erosion. Practically any part for a cracking unit is now available in alloy steel. Alloy liners are being successfully used in cracking vessels for corrosion protection. Cement linings are also used for protecting pressure vessels. In the design of cracking units the trend has been toward larger capacities, utmost safety of operation, and greater flexibility as to the type of charging stock and the control of the properties of the products. Better yields of quality products and lower operating costs have resulted.

Whitman[2] states that metals intended for high temperature service in refineries should possess some or all of the following properties:

1. Inherent stability in the working range.
2. High creep strength in this range.
3. Resistance to corrosion and scaling.
4. A satisfactory impact strength.
5. High heat conductivity.
6. Low thermal expansion.
7. Workability.
8. Ductility at high temperature, for evidence of distress before failure.
9. Tough hardness to resist wear of tube cleaning.
10. A high fatigue limit.
11. Weldability.

Since no single alloy possesses all of these properties those characteristics most desirable for a certain service will be the important considerations. It is pointed out that proper furnace design and operation can definitely limit the temperature to which an alloy is subjected.

The committee on refinery corrosion of the American Petroleum Institute has outlined various methods for eliminating corrosion losses:

1. Use of extra thickness of material on exposed surfaces where more economical than special alloys.
2. Use of special alloys having high resistance corrosion at critical locations, such as valves, control points, and parts subject to high velocities where erosion hastens corrosion.
3. The use of protective coatings, metallic or non-metallic.
4. The use of neutralizers, caustic, soda ash, lime, or ammonia.
5. Dehydration of crude where desirable and easily accomplished.

A method of warning against internal wear in high pressure equipment, which is an important safety measure, has been developed recently. Small holes are drilled part way through the walls of the tube or other pressure part. These holes are made cone shaped at the bottom, and whenever the wall becomes thinned to the safety limit a tiny leak appears. The volume of fluid escaping gradually increases as the wear proceeds due to the increasing diameter of the hole. Tests show that this drilling does not weaken the tube. Tubes thus drilled can now be obtained from the manufacturer.

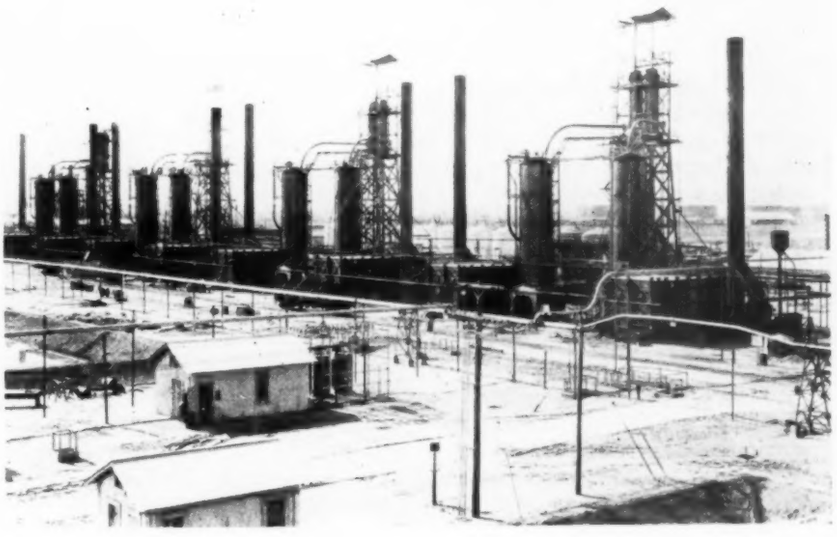
Alloy Steels

The alloy steels used in the manufacture of cracking still tubes, supports, valves, fittings, and other parts, include: low-chrome, chrome-nickel, chrome-molybdenum, and chrome-tungsten.

On account of its superior resistance to corrosion and ease of fabrication the iron chromium nickel alloy, containing approximately 18 per cent chrome and 8 per cent nickel, has a wide application for furnace tubes. This alloy is noted for its high ductility and ability to withstand cold working. This material shows a high resistance to oxidation up to 1600 degrees F., and strength at elevated temperatures at least to 1200 degrees F.

A low chrome still tube, containing 4 per cent to 6 per cent chromium, has been developed for use in cracking service, and their performance has been very satisfactory in many installations.

After years of research work manufacturers of valves, return bends, and fittings have developed special lines that show splendid performance in cracking plant service. Some of the



[1]Annual Petroleum Statement, page 94, U. S. Bureau of Mines.
[2]A. S. T. M. and A. S. M. E. Symposium, Effect of Temperature on Metals.

alloy steels used to withstand the erosion and corrosion prevailing at high temperature and pressures are:

Chrome molybdenum alloy cast steel has high creep stress resistance and great strength at elevated temperatures in addition to its corrosion and erosion resisting properties.

Chrome nickel alloy cast steel is heat treated to refine the grain and relieve internal strains. It is used where higher strength and resistance to erosion are important.

Nitrided steel is special steel which is given an extremely hard non-corrosive surface by heat treatment with ammonia gas.

Chrome tungsten steel valves designed for severe cracking plant conditions have recently appeared on the market.

Alloy steel tube supports are widely used in the construction of cracking furnaces. Tube supports must not only be immune to oxidation, but display extreme stiffness at elevated temperatures. Special alloy steel castings for service up to 2000 degrees F. are produced commercially.

Welding

Welding is now almost universally used in the fabrication and erection of refinery equipment. Thick-walled welded vessels have been accepted by the refining industry for service under high temperature and pressure. Due to the rapid progress in the application of welding in piping installation complete lines of welding fittings have been developed by progressive manufacturers. The fabrication of fittings in the field is no longer necessary. The use of special welding fittings is not only economical, but the installation requires less space, can be easily insulated, and is lighter in weight. Welding fittings are now available with guaranteed pressure ratings and ample factor of safety.

A properly designed furnace for the correct application of heat to the oil is the most important part of the modern cracking unit. In recent years methods of design, materials of construction, and auxiliary equipment have been greatly improved. This remarkable progress has been discussed in detail in previous articles.

Hot Oil Pumps

Both the reciprocating and the centrifugal pump have been developed for high pressure hot oil service. Of the former single and duplex direct acting steam pumps, crank and flywheel steam pumps, and gas engine driven hot oil pumps using refinery gases as fuel are in use. Absolute safety, steady operation, unvarying capacity, and uniform flow are important characteristics. One of the manufacturers of hot oil pumps points out that improper mounting of fluid cylinders is responsible for much trouble. A solution of the problem is to mount them so they float in their mountings. The fluid cylinder is mounted on two water cooled saddles. The cylinder is supported at the center line of the bore, permitting expansion in all directions with no change in alignment. The fluid cylinders are made of steel forgings machined from the solid. In order to prevent any possible leakage at the plungers a very deep stuffing box is added so that the hot part of the plunger never runs into the packing. This stuffing box is provided with a water jacket, designed for maximum cooling with the minimum amount of water. The outer wall may be readily removed and the jacket cleaned.

Many installations of gas engine driven hot oil pumps, using refinery gas as fuel, have been made. They have proven economical and efficient. Safe and reliable centrifugal pumps are also used in cracking plant service for hot oil. For extra heavy duty a twelve-stage pump, standardized in sizes from 150 to 600 gallons per minute, to handle oils up to 850 degrees F., and differential pressures up to 1500 pounds per square inch is made by a leading manufacturer.

In this type of pump the outer case is supported along its horizontal axial plane in a cradle, so that no misalignment of the shaft results from great temperature changes. It is designed so that both stuffing boxes are under low pressure.

A remarkable safety feature has been developed for this type of pump. A totally enclosed externally operated gland mechanism and stuffing box controls any escape of liquid or vapor from the stuffing box, and a steam smothering line can be connected.

Heat Exchangers

Heat exchangers for 830 degrees F. and 1000 to 2000 pounds operating pressure are in successful operation. Features of design used by a leading manufacturer are vapor nozzles with tapered adapters to reduce impact of vapors on the tubes and thus prevent localized erosion opposite the inlet, and increasing the life of the tubes. Corrosion resisting welded shells on high temperature exchangers eliminates rivet heads and caulked joints.

A recent development in heat exchangers is a section made up of four straight parallel tubes expanded simultaneously into the heads, and into diamond-shaped fins. At the floating head end, the closer spaced pair of diagonally opposing tubes are connected by a passage in the head itself, while the wider spaced pair are connected by a spherical seated steel return bend. The passages in the stationary head, tubes and return member are all of equal cross section so that both hot and cold fluids flow through the entire unit at uniform velocity.

These sections are operated with the hot fluid passing and returning through two diagonally opposing tubes and the cold liquid passing and returning through the other pair of tubes. The many fins surrounding the tubes conduct the heat from the tubes carrying the hot fluid to the tubes carrying the cold liquid, and are usually insulated to conserve heat. The units are interchangeable, and may be set up in stacks with parallel or series connection for the desired capacity or temperature range.

A high strength fabricated design for shells, channels and covers of heat exchangers, known as lock-forged construction, has been developed. In this construction both shell and channel are welded steel cylinders. A narrow flange is formed on the ends by rolling and upsetting the metal in a flanging machine. The flanges thus formed are the bearing surfaces for the lock forged joints and are finished by machining all over. The flanges are stiffened and supported by loose rolled steel backing rings, which are machined on all bearing surfaces, and which are either drilled for bolts or provided with a groove on the back side for hook bolt bearing. All bearing surfaces of the joint are recessed by overlapping of the cover or the backing up ring. The metal gaskets cannot be blown out. Shell cover and floating head cover are attached by means of high strength forged steel hook bolts. In breaking these joints the bolts are released by backing off the nuts a few turns only. This construction is recommended for withstanding high pressures and wide temperature fluctuations.

Control Equipment

Automatic control apparatus for temperature, pressure, rate of flow, and liquid level has been developed to a high degree of accuracy and reliability. The great progress made by manufacturers of control instruments and devices have contributed greatly to the development of cracking units to their present state of efficiency.

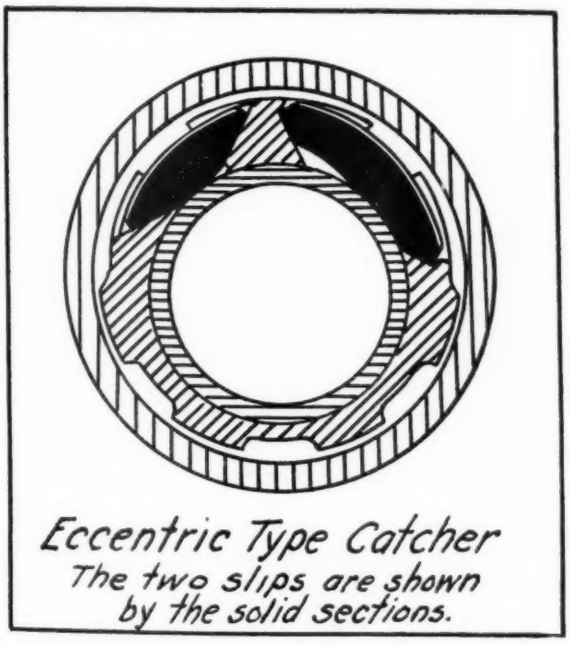
Anchored Tubing Proves Effective

By W. A. SAWDON
Petroleum Engineer, Los Angeles

Up to a very few years ago, pumping depths never exceeded 5000 feet. With deeper holes being drilled it was realized that wells of greater depths would eventually have to be pumped. With the advent of these deep wells it was also expected that pumping troubles would increase. Of considerable importance among the many other problems thus set up were those of wear on the tubing and the increased labor and expense attending the frequent pulling and running of 6000 and 7000 ft. strings. Means of decreasing this wear were naturally given attention and among the methods advanced, that of anchoring the tubing near its bottom has given results that have proved beneficial in several ways.

In the Santa Fe Springs field in California, pumping from depths of from 6000 to 7000 feet is frequently found to be accomplished by excessive wear on the tubing couplings. A considerable part of the trouble is felt to be caused by the vertical movement of the tubing and its whipping while the well is being pumped. One company first tried out using bronze protectors that were similar to those of the rubber design but fluted.

The tubing travel increases with the smaller diameter tubing and most of the strings of the deep wells in this field are 2¼-in. to 2½-in. in diameter. These strings are also frequently run in casing of diameters from 4¾-in. to 6⅝-in. The clearance between the tubing and the casing is, therefore, small and any vertical movement in the former will naturally be accompanied by a wearing of the tubing couplings. In order to eliminate this movement in the tubing it was then decided to anchor it just above the perforations.

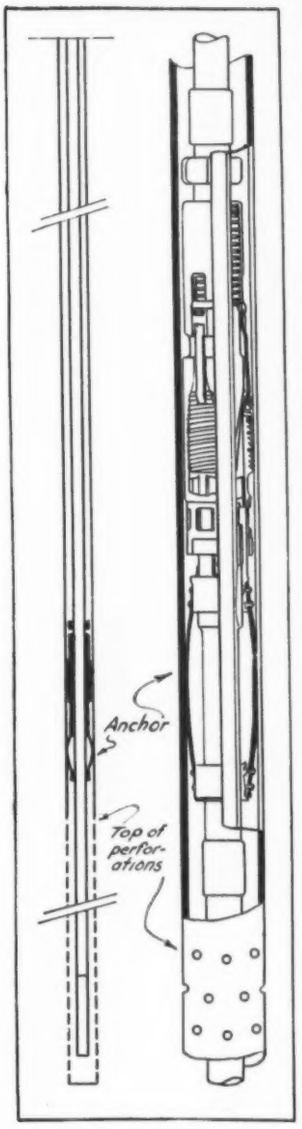


When clearance between the tubing and casing is small, the eccentric type of catcher, equipped with an anchor, is used

A tubing catcher with a mechanically operated anchor is run on the string and set at a predetermined point above the perforations. The type being widely used in the Santa Fe field and now to an even greater extent in the Long Beach field is shown in the accompanying illustration.

When the anchor reaches the desired depth, the tubing is turned to the right. This causes the setting sleeve to actuate the tubing catcher and set the slips against the casing, thus preventing the tubing from descending farther. The tubing, held at the bottom, is next set down with all its weight. It is then picked up to within 10 or 12 inches of the point where it would release the catcher, and there hung.

Only one-sixth of a turn of the tubing is required at the anchor but in the 7000-ft. wells, from one and one-half to two and one-half turns are necessary at the derrick floor. The total stretch in 2½-in. tubing at this depth has been found to be from 60 to 66 inches, with the fluid level, of course, having considerable influence.

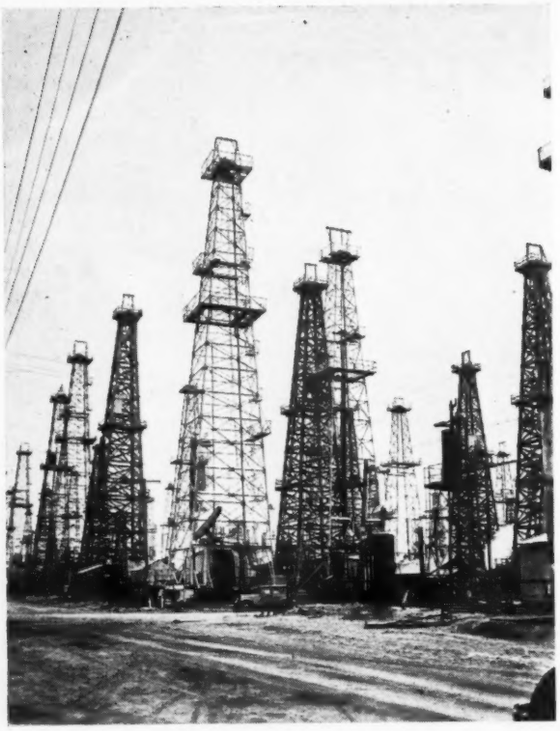


Set by the anchor, the tubing catcher anchors the tubing just above the perforations and holds it there until pulled

Due to the limited clearance between the tubing and the casing when the small diameter strings have to be used—as is frequently the case in the Santa Fe Springs and Long Beach fields—the standard type tubing catcher is not always adaptable. To overcome this difficulty, an eccentric type of catcher is used, a section of which is here shown. This eccentric catcher is necessary in order to get the requisite strength for such long strings of tubing. As can be seen in the drawing, the slips are two in number and are both located on one side. The catcher is mounted eccentrically on the tubing but the top and bottom guide collars are placed concentric with the casing.

While for safety in running the tubing two catchers should be used for these great depths, the one catcher actuated by the anchor and placed near the bottom of the string has been found adequate for holding the tubing without slippage during pumping operations. This applies to the eccentric type as well as the standard. For instance, one well in the Santa Fe Springs field is producing from a depth of 7200 feet with a string of 2¼-in. tubing anchored with an eccentric catcher in 4¾-in. pipe.

The results obtained by anchoring tubing to prevent collar



Though derrick locations almost overlap in parts of Santa Fe Springs field, these wells do not all produce from the same horizon. Many are now pumping from depths of 6,000 to 7,000 feet.

wear and whipping have been gratifying. In one well, the tubing has not been pulled since the anchor was used, previously it had been necessary to replace 20 worn couplings a week. In another that was anchored seven months ago and has not been pulled since, the replacement of from 40 to 50 couplings every two weeks has been eliminated. Many similar instances could be cited with the number of replacements eliminated depending on the amount of wear that had been going on before the tubing was anchored.

The deeper the well, the more costly is the pulling and rerunning of tubing. Also, the deeper the well, the longer will it be off production during such repair work. In the deep wells, the anchoring of tubing in the smaller casings—from 4¾-in. to 6⅝-in.—in both the Santa Fe Springs and Long Beach fields has thus been economical when considered from the standpoint of coupling wear alone.

Another beneficial result has, however, been noted after the long strings of tubing have been anchored. While not primarily an objective in setting the anchor, it has been found that an increase in production has frequently followed. In explaining this, those in charge of production have concluded that they were not getting the full length of stroke due to the vertical movement of the tubing during pumping operations. With the tubing held stationary, this motion has been stopped and the length of stroke desired is more nearly approached.

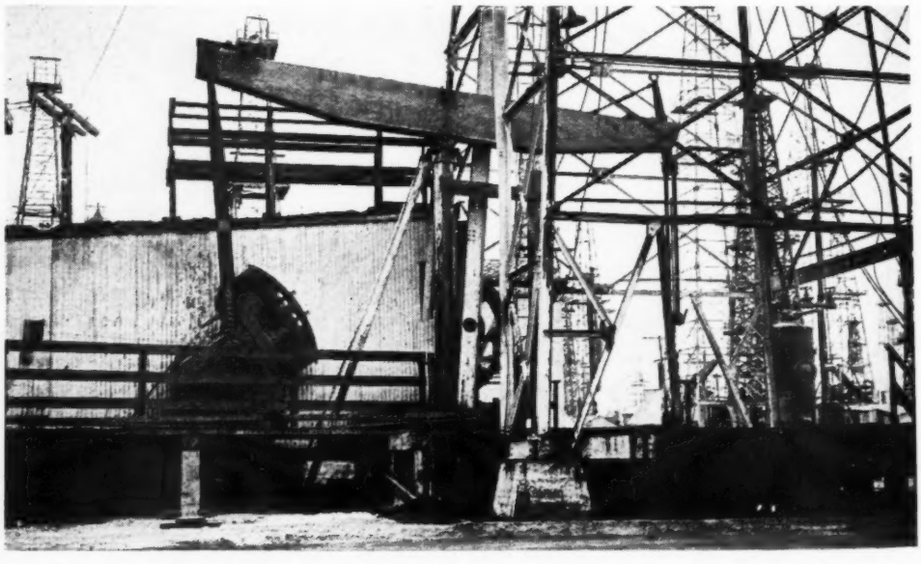
No discussion of pump efficiency or stroke determination will be given here but it is felt that the anchored tubing has aided materially in getting more efficient pump performance. When the fluid is not in the hole, no increase in production can naturally be expected. One well in the Santa Fe Springs field, for instance, increased from 150 barrels a day to from 190 to 210 barrels a day after the tubing was anchored.

Another influential factor is the effect of steady production without shut-downs for tubing jobs. This is especially important when any considerable amount of water is being produced with the oil. In one well that was cutting 49 per cent and making 115 barrels a day the tubing was anchored to cut down coupling wear. The tubing did not then have to be pulled at frequent intervals with the result that the steady, continuous production kept the water off the sand and allowed the oil to flow into the hole more freely. Production of oil gradually rose to 203 barrels a day, an increase of over 75 per cent.

Another interesting result that followed the anchoring of the tubing in a deep pumping well was an evident increase in mechanical efficiency. The well, equipped with a crank-type counterbalance, was making 240 barrels a day in the third hole. When the tubing was anchored, it was put into the second hole and the production rose to 320 barrels a day. The well was electric motor driven and lower power bills also resulted.

Most of the tubing strings that have been anchored in the Santa Fe Springs and Long Beach fields to date have been 6000 feet or longer, although one has been as short as 4700 feet.

The movement of the tubing is probably affected differently by the degree and direction of inclination in each hole to a considerable extent; but an examination of worn couplings on the tubing should indicate whether or not it would be advantageous to use an anchor. In crooked holes, of course, even a very small movement of the tubing can be more serious than the same amount in a straight hole. Moreover, movement in larger diameter casings might also be more detrimental in crooked holes than it would be in holes that have no bends or turns. In any event, the results obtained by anchoring long strings of tubing in small pipe have demonstrated the possibilities of eliminating wear when the clearance between the tubing and casing is small and the movement due to stretch is of an appreciable amount.



In this well in the Santa Fe Springs Field, California, being pumped from a depth of 7,000 feet, tubing trouble was eliminated and production increased by anchoring the tubing just above the perforations. The type of counterbalance here shown has been used very successfully, pumping from this great depth

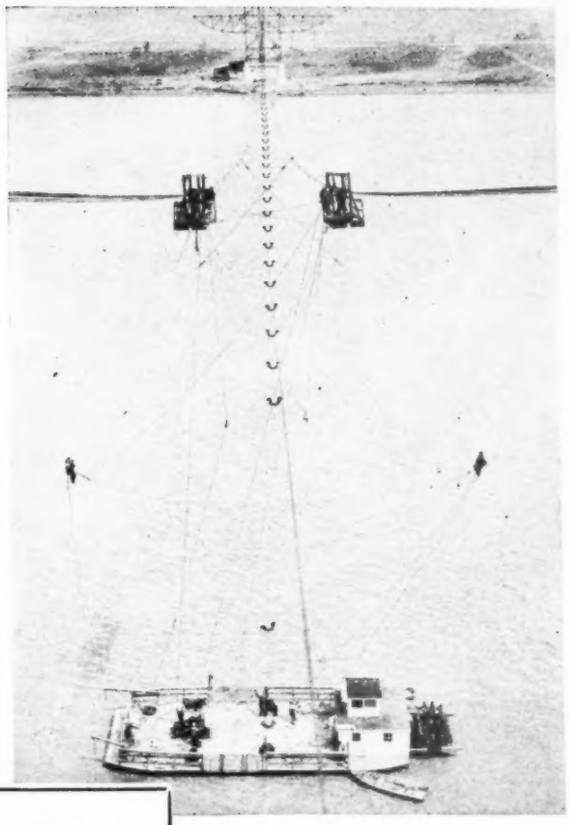
Single Span Natural Gas Pipe Line Bridge

By GORDON R. LUNT*

BLINDING blizzards, temperatures 20 degrees below zero, roads blocked with snow drifts, high winds, ice jams 30 feet high, spring thaws making roads impassable, were some of the difficulties encountered in constructing the longest known single span natural gas pipe line suspension bridge over the Missouri river near Ponca, Nebraska, by the Pittsburgh Des Moines Steel Company, Des Moines, Iowa, during the winter of 1931-32. This unusual structure was designed by Matthews & Kenan, Consulting Engineers, San Antonio, Texas, and constructed for the Northern Natural Gas and Pipe Line Company, owners, under the supervision of the Lone Star Gas Company, Dallas, Texas, one of the owners of the Northern Natural Gas and Pipe Line Company, with L. A. Delmas and Paul King acting as construction inspectors.

This imposing structure is 1280 feet from center to center of the main towers, while 2369 feet from back face to back face of concrete anchors. The towers rise 158 feet above low water, while the 16-inch welded steel pipe at 70 degrees F. is 59 feet and 6 inches above standard high water. Each main cable is composed of seven galvanized bridge strands which are served together with No. 10 galvanized wire spaced one-inch centers. Each wind cable is a single wire rope, while all suspenders are Simens-Martin strand.

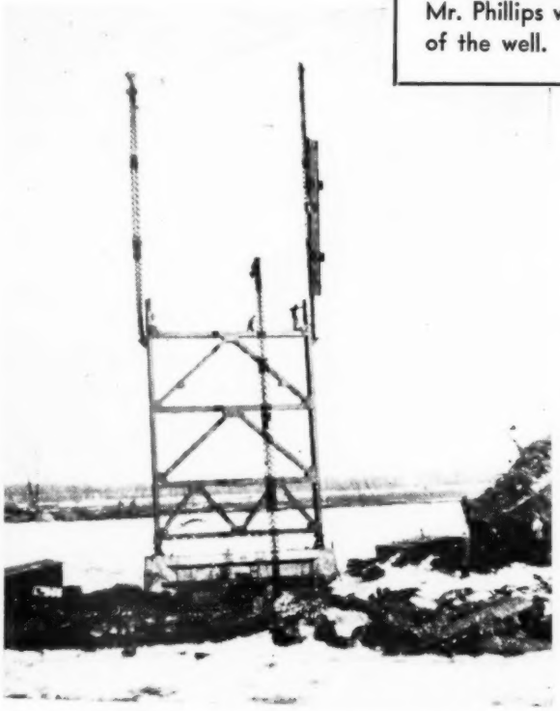
Actual construction was started on the Nebraska side December 1, 1931, while due to the delay in securing government approval, construction was not started on the South Dakota side until December 12, 1931. All concrete work was completed on February 28, 1932, while the structure was ready to receive the pipe April 16, 1932, which was placed by the Lone Star Gas Company. Operations were carried on during very trying weather conditions which materially delayed progress of the work. Many blizzards were experienced and improvised roads leading from the gravel to the bridge site for days at a time. It was necessary to remove the snow from the road on either side of the river before the bridge site could be reached. When the spring thaw started, it was necessary for the men to use horses and wagons to go to and from the work, and at times, the roads became impassible even for this mode of transportation, necessitating a walk of three and one-half miles on the Nebraska side and two and one-half miles on the South Dakota side.



Erecting suspension system.

THIS MONTH'S COVER

The very beautiful and unusual scene entitled "An Oil Country Storm at Night," was photographed in Montana a few years ago and shows Poss Petroleum Company's No. 1 well. We are indebted to A. P. Phillips, Calgary, Alberta, Canada, for use of the picture. Mr. Phillips was in charge of the drilling of the well.



Erecting structural steel on the Nebraska side.

Due to the severe weather, it was necessary to heat all the materials as well as the water. All aggregate was piled on steam coils and steam was kept moving through the coils several days in advance of actual concrete pouring. All piers were housed in as well as all equipment. It was necessary to pour concrete when the temperatures were as low as 10 degrees below zero. High early strength concrete helped materially in combating the severe weather.

The Nebraska main sub-pier was of steel caisson construction, and carried down through sand stone to a depth of 46 feet below ground elevation, while the South Dakota main sub-pier was of concrete caisson construction, and carried down by open dredging to a depth of 52 feet below ground line. After the South Dakota sub-piers had been brought to elevation, H-beams 60 feet long were driven in the bottom and then sealed off with a tremie.

The first sections of the main towers were erected by the use of

* Manager Bridge Department Pittsburgh Des Moines Steel Company, Des Moines, Iowa.

Finished pier on the South Dakota side.

derricks, the remainder of the towers were erected by the use of gin poles which were jumped up the columns as the work progressed. After the towers were completely erected, the wind arms were erected as cantilevers, using a Chicago boom seat on the face of the columns. As the towers were pin connected at the base, it was necessary to guy these by some method during construction. It was deemed more economical to guy these from the towers to their pier on the opposite side of the river and then back to the anchor, and this method was used. It was destined to cause some worry when two severe ice jams were encountered. The main cables, wind cables, suspenders and pipe cradles, as well as all cable serving were erected by special methods particularly adapted to erection of pipe line suspension bridges.

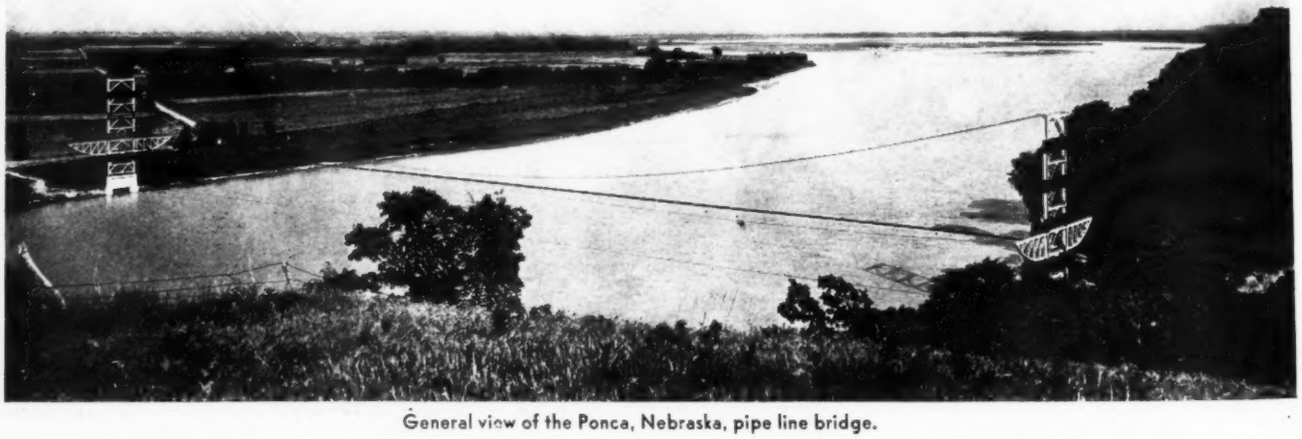
Nine miles of permanent cable and 13.3 miles of No. 10 wire went into the finished structure. All structural steel was furnished from our Des Moines plant while wind cables and suspenders were furnished by the American Steel and Wire Company.

In properly concluding this article some highly relevant facts may well be mentioned. Both the design and construction of this structure involved some unusual and unprecedented problems, and it should prove of interest to the reader to know that many of these problems had to be anticipated and provided for in the design, while other problems involving actual construction had to be anticipated and taken care of as actual construction progressed, by the most careful and thorough coöperation between the designing engineers and ourselves in order that the proper and vitally necessary coördination between design and construction was maintained.

The fact that such problems might well have been anticipated in such an unusual structure is so well brought out in a letter written to us by a wire company just prior to the actual construction that we feel justified in quoting from this letter.

"Your span of 1280 feet places this particular bridge in the class of the larger bridges, and, in fact, it has the longest span of any of the strand bridges at the present. The St. Johns Highway bridge at Portland, Oregon, with a main span of slightly over 1200 feet is now the longest. We are merely mentioning these facts, not meaning to definitely predict trouble, but more to give warning of possibly more difficulty in erection and adjustment than you have possibly had on any of your previous pipe line suspension bridges. As stated above, the system of stays, ties, etc., produces a variable factor into the calculation of the entire system. We hope, however, that our predictions will all be in vain, and that you will experience no more difficulty than warranted by the size of the proposition."

Although this bridge, now as a completed structure, appears comparatively simple, although imposing, it should well be realized that except for proper design followed by careful coördination between design and construction thereafter, the structure might well have been a failure. The satisfactory completion of this structure has convinced us of the practicability and feasibility of such bridges of much greater single span length and, therefore, we predict that this bridge will not long hold the distinction of being the longest single span pipe line suspension bridge in the world.



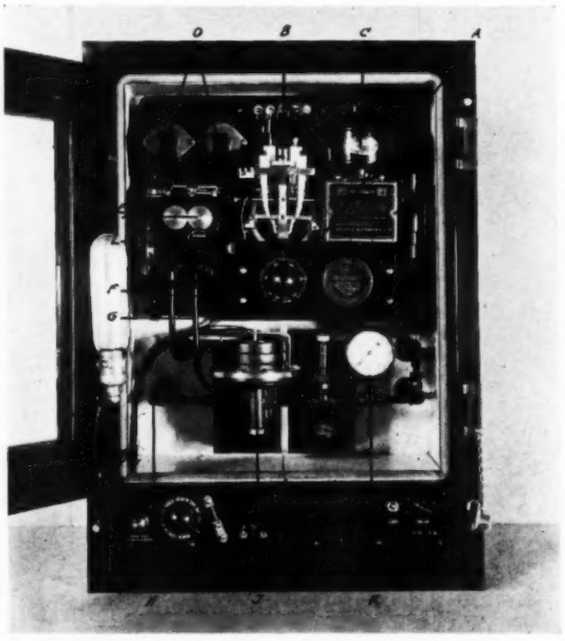
General view of the Ponca, Nebraska, pipe line bridge.

Cracking Plant Temperature Control

ACCURATE control of the transfer temperature is of primary importance for the efficient and economical operation of present-day cracking units. Manufacturers of control instruments and devices have made remarkable progress in the development of this type of equipment for cracking plant service.

The Deflorez control consists essentially of a Leeds and Northrup potentiometer controller with an attachment whereby the fuel control contacts are made through the cam mechanism, which results in an electrical contact which is directly proportional in duration to the deflection of the galvanometer which deflection in turn is directly proportional to the temperature either above or below the point selected.

Referring to the photograph, the potentiometer pyrometer is shown on the upper right hand corner, with the motor at "C" and the galvanometer and cam mechanism marked "B." The relays operated by the cam mechanism are shown in the upper left corner "D." Directly below the relays is a square black box which is the "heart" of the Deflorez mechanism, the Geneva gear movement. Under this box is located the pilot valve that translates temperature deviations into corrective adjustment of the fuel valves.



Cracking Plant Temperature Controller

The pilot valve is really a bleeder valve, too, with the amount of the bleed under the control of the pyrometer mechanism. It is the piston type, with a spring pressing against the force of the operating lever. This spring is merely a stabilizer and has nothing to do with calibration. The plant air supply enters the circuit through the piping at lower left of case, after passing through strainer, and passes through the dead weight pressure regulator "J", then a needle valve, past the pressure gauge "K" and leaves the case at lower right going to the balance fuel valve. The needle located between "J" and "K" regulates the operating pressure and from this needle valve the air is piped to the under side of the diaphragm "J" and thence "F" to the needle valve under the Geneva gear box. The pipe "G" is the atmospheric leak from the latter needle valve.

The thermo-couple is located in a cross-over several tubes back from the transfer line or coil outlet.

The balanced fuel valve is located in the main fuel supply line. It is a diaphragm-operated piston valve placed between block valves in the line, and a by-pass is installed around this valve, having a manually-operated valve.

The air line, mentioned before, from the instrument is attached to the top of the Deflorez valve. Control-air pressure on the top of the diaphragm is counter-balanced by fuel main pressure on the lower side, thus the diaphragm material is not subject to any great strain. A bleeder valve on the under side of the diaphragm chamber can be opened to relieve any accumulation of fuel main pressure that might occur when the control-air pressure is turned off.

The temperature control is guided by the potentiometer pyrometer. By setting the dial "A" at the desired temperature, an electric potential of definite value is established. When this potential is exactly balanced by the e.n.f. of the thermo-couple, located in the oil line, the pointer of an extremely sensitive galvanometer "B" remains motionless "on center." If the thermo-couple reports a temperature above or below that desired, the pointer swings to one side or the other of the center, the length of swing being directly proportional to the temperature's departure from normal. The motor driven mechanism makes mechanical contacts with the pointer at regular intervals. According to whether the departure is above or below normal, this mechanism takes steps to turn the fuel supply off or on until the thermo-couple reports in agreement with the setting of the dial. It is important to note that when conditions are steady the adjustment mechanism "stands by."

At the instant of "making a reading" there is no flow of current in the thermo-couple leads, hence, no errors occur due to changes in electrical resistance caused by corrosion or not entirely secure junctures along the line. Compensations for variations of the "cold" and of the thermo-couple within the case, are made by a single coil of wire.

After setting the temperature dial "A" to the desired point and setting the pressure gauge "K" to the operating burner pressure the instrument is prepared to control.

A change of temperature either up or down at the thermo-couple deflects the galvanometer needle and one of the cams makes the contact that operates one of the relays "D", the duration of the contact being in accordance with the degree of temperature variation.

This action of the relays opens or closes the needle valve on the bottom of the Geneva gear box. The length of stroke of the relay armature is fixed; hence, the time the pilot valve is moved from "neutral," towards its open or closed positions, is also in line with the temperature swing.

Increasing or decreasing the needle valve will increase or decrease the air pressure, as shown on gauge "K" to the balanced fuel valve. Hence, the pressure in the control-air line to the balanced fuel valve is varied just the right amount, resulting in perfect correction at the point of the control in the hot oil line.

When the cam contact is broken at "B" the relay "D" falls out and the needle valve, under the gear box, returns to neutral position, and the pressure set on the gauge "K" returns to original.

When there is a persistent trend away from normal and it extends beyond the predetermined length of time, the pilot valve, under the gear case, is automatically shifted to a new neutral position and in so doing changes the operating pressure on the balanced fuel valve as shown on gauge "K."

Spraying Molten Metal to Combat Corrosion

UTILIZING a relatively new method that permits spraying molten metal on practically any type of surface, several oil industry operating departments are successfully combating corrosion on certain equipment and extending the life of some equipment subject to wear. The process permits the spraying of both hard and soft metals and their alloys to practically any base.

The mechanism of the spraying gun, through which metal in the form of wire is fed automatically, melted with oxy-acetylene, and shot out of the gun at extremely high velocities by means of air pressure, may be divided into two essential parts: the wire feed mechanism and the gas head. The gun is about four inches square and equipped with a grip handle for ease in handling.

The wire feed mechanism is enclosed in a box case. In the rear part of the case is a small 12-blade turbine, powered by air to drive the gears and a knurled feed roll which feeds the wire through the gun at the proper speed. The top part of the case is hinged and located on top is a pressure plunger fitting directly over an idler shaft yoke. The plunger is used to supply the necessary pressure to the yoke to enable the knurled roll to properly engage the feed wire.

The main body of the gas head, in which the oxy-acetylene flame melts the metal at the tip of the wire nozzle, at which point the molten metal is atomized by air pressure and shot out, is attached to the case. Between the case and gas head body are the orifice plates for the mixing and metering of gases. From the orifice plates the gases pass to the main gas head body to ducts that cause the flame to burn in a conical shape similar to a properly burning flame on an ordinary acetylene torch. The smoothness of coating is dependent upon adjustment of the air cap that regulates the stream of air, which completely surrounds the gas flame.

Coating an exhaust ell with aluminum

Hose connections for air and gases are located at the front bottom of the case and control of air and gases is obtained by means of a taper valve and adjustment screw. The gas tanks are conveniently located and air pressure may be obtained either from a permanent compressor unit or portable unit with a capacity of about 125 cubic feet. Hydrogen or acetylene either may be burned. Air and gas pressures are controlled at the regulators to about the pressures given in the accompanying table.

To light the gun the operator threads wire through the wire feed mechanism and turns on the air pressure. The taper valve is opened as the turbine picks up speed. Its speed is increased until it turns over about 30,000 r.p.m. The top of the case is closed and the plunger is adjusted. Wire feed speed is adjusted by manipulation of the taper valve. Gas tanks are then adjusted and the gun is lighted in a manner similar to lighting an oxy-acetylene torch. Proper adjustments are made at the nozzle and to the valves so that the molten metal leaves the nozzle in a fine spray.

The gun permits spraying of any commercial metal on practically any other commercial metal. The bond is made by force of impact on a thoroughly sand blasted surface, rather than fusion of the two metals. Metal in wire form is fed through the gun, melted, atomized and shot against the sand blasted surface at a speed of about 33,000 feet per minute. The terrific impact drives the atomized spray in the pores of the metal where it cools almost instantly, forming a sheet metal coating over the surface. With a properly prepared base the metal coatings become practically an integral part of the base on which they are applied.

In operation, the gun is held directly or nearly directly over the work and never should the spray be directed at an angle greater than 45 degrees to the base. Coating may be applied to any reasonable thickness. In building up material several coats must be applied. In a general way, a single coat of high melting point metal is sprayed on to a thickness of about .002 inches and the lower melting point metals about .003 inches.

Perhaps the greatest field open to the process in the petroleum industry is in combatting corrosion of material exposed to weathering, rust, heat and chemicals. Various types of metals, available in wire form, may be used to attack the particular problem.

In spraying metals to combat corrosion it is important to apply sufficient material to be reasonably sure the coating is not porous. Particularly is this true in the application of metals that are electro positive to iron. If it is not economical to apply several coatings under such conditions an undercoating of zinc may be used. Numerous applications of combination material have been made and after several months of exposure the coated material apparently was found to be in excellent condition.

Selecting the proper metal or metals to be used for any application should embrace a thorough consideration of all the physical properties of a metal along with a study of the conditions under which it will be used before the recommendation of a metal is made.

Considerable work has been done in the coating of agitators for refinery work. The tanks are thoroughly sand blasted and sprayer with lead. Condenser boxes have been successfully coated with pure lead.

One of the major gas transmission companies is using the

EASY TO RECLAIM

and Easy to Re-lay

Here you can see the advantage of using simple, demountable, durable joints. This gas line in Kansas was quickly reclaimed and relaid with practically no loss of material. If your gas lines are Dresser Coupled, it is always possible to take them up and re-establish them elsewhere with a minimum of effort and expense.

DRESSER COUPLINGS

Dominate!

If the pipe in a Dresser-Coupled line ever needs reconditioning, the Couplings are readily unbolted and just as readily bolted again. Pipe that has become pitted on the bottom can be turned over and put in shape for many years of additional service. Two maintenance-saving features of every Dresser line, regardless of its age, are ABSOLUTE tightness and extreme flexibility of the joints.

S.R. DRESSER MANUFACTURING CO.
BRADFORD, PA.
In Canada: Dresser Mfg. Co., Ltd., 32 Front St., W., Toronto, Ont.

process to coat exhaust ells on gas engine driven compressors with aluminum. On these engines the temperature in the exhaust ells is about 1100 degrees F.

The ells were sand blasted and an aluminum coating approximately .008 inches thick was applied. The coats were applied in four successive applications. Some of the ells have been in service more than 10 weeks and the aluminum coating apparently is adhering as tightly as the day it was applied. In transporting the ells from a central warehouse to the field no particular care was exercised to handle the ells with the view of protecting the coating. It required about 10 minutes time to apply the four coats of sprayed aluminum.

One major gas company has a metal spray gun in its shop and is planning to do considerable experimental work with this process. This company will metalize some of its equipment subjected to severe attacks of corrosion. Thus far all of the material coated for protection against corrosion or rebuilt has given satisfactory service.

One of the most important steps in using the process is in the preparation of the metal to be sprayed. To insure a good bond it is necessary to thoroughly clean it by sand blasting. This removes all foreign material and roughens the surface to be coated. Unless the surface is properly roughened the sprayed metal will not adhere to the surface.

Microphotographs clearly indicate the results obtained when metal is sprayed on smooth surfaces and rough surfaces. When sprayed on a smooth surface the molten metal has a tendency to glide before coming to rest. In doing so it requires a certain amount of time, permitting it to cool to a certain extent. Following its gliding movement the metal will rise slightly before coming to rest and as the metal is continually sprayed to the smooth surface the coating forms in small waves. Consequently, the coating contacts the surface only at intervals and does not bond or adhere tightly.

When the surface is sand blasted sharp elevations and depressions are made on the sorface. As the molten spray is shot to this surface the metal comes to rest instantly and bonds itself firmly in the depressions and to the elevations of the roughened material.

A good grade of sand is required to properly prepare metal surfaces. Most frequently a silica of 16 to 20-mesh is used to sand blast metal surfaces and anywhere from 30 to 100 pounds of air pressure is used by the sand blasting equipment. Pressure depends entirely upon the metal being sand blasted.

Cost of applying sprayed metal coatings varies with the type of metal used. The softer metals may be coated at a cost ranging from three and a half to six cents per square foot per coat. This price does not include the cost of sand blasting. Because of their slower application speed the hard metals cost slightly more to spray per coat. Average spraying time of various metals is given in the table of pressure adjustments.

This process is owned by Metalizing Company of America, Inc., Los Angeles, Calif.

TABLE OF PRESSURE ADJUSTMENTS FOR VARIOUS METALS AND APPLICATION SPEEDS

Metal	Wire Size	Acetylene Pressure	Oxygen Pressure	Air Pressure	Wire Speed Per Min.	Av. per Hr. per Ct. Speed Sq. Ft.
Lead - - -	14 Bir	15 lb.	18 lb.	60 lb.	17 ft.	120
Tin - - - -	14 Bir	15 lb.	18 lb.	60 lb.	18 ft.	120
Zinc - - -	16 B&S	15 lb.	18 lb.	60 lb.	17 ft.	120
Aluminum -	18 B&S	15 lb.	m18 lb.	50 lb.	12 ft.	60
Copper - -	18 B&S	15 lb.	18 lb.	50 lb.	12 ft.	
Brass - - -	18 B&S	15 lb.	19 lb.	50 lb.	15 ft.	80
Phos. Bronze -	18 B&S	15 lb.	19 lb.	50 lb.	13 ft.	
Nickel Silver -	17 B&S	15 lb.	16½ lb.	60 lb.	11 ft.	50
Monel - - -	18 B&S	15 lb.	16½ lb.	60 lb.	5 ft.	
Stainless Steel	18 B&S	15 lb.	18 lb.	60 lb.	7 ft.	

Metal Spraying Equipment and Sand Blasting Equipment in shop

VAPOR PHASE REFINING

Fully Patented

The Gray Processes Corporation owns outright or has exclusive licensing rights in its field to more than forty United States patents as well as patents in most foreign countries. The licensing rights include those under the Vapor Phase Refining patents covering treatment of cracked gasoline issued to the Cross Development Company, Atlantic Refining Company, Sinclair Refining Company and others.

That the responsible portion of the petroleum refining industry has acquiesced in the utility of the process and the strength of the patents is attested by the list of Gray licensees on the opposite page.

Infringers will be vigorously prosecuted.

THE GRAY PROCESSES CORPORATION

961 FRELINGHUYSEN AVENUE

NEWARK, NEW JERSEY

Operating Features of One of C

By ROBERT V. N

CALIFORNIA refineries and gasoline plants, while constructed by basic theoretical formulae, as in all other such plants, have kept pace with progress and offer some interesting studies in efficiency, flexibility, safety and economy. It is the intention of the author to present from time to time in these pages a description of certain ones of the most unique plants and the outstanding features of their make-up. The order in which they are dealt with is not indicative of their relative position in the industry, but is dictated only by accessability of the material.

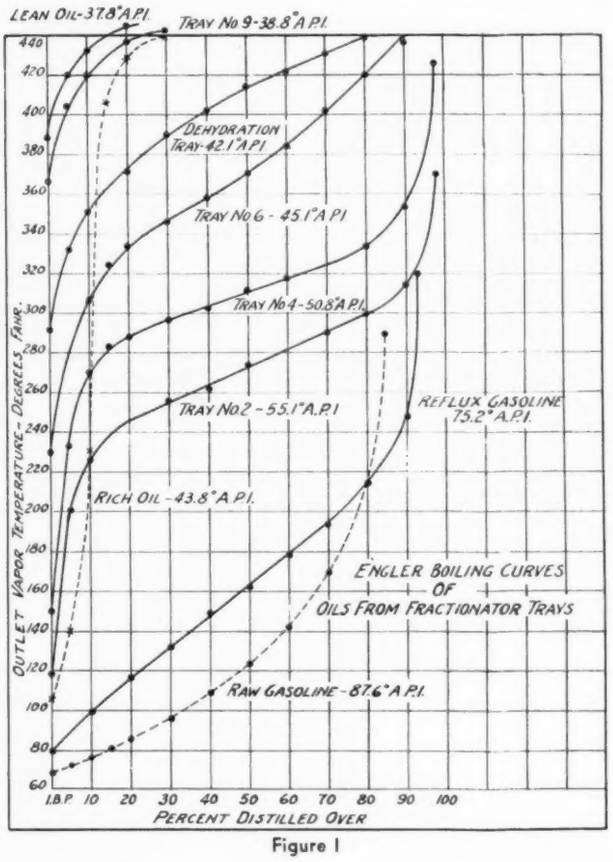


Figure 1

The gasoline plant of the Los Nietos Producing & Refining Company, of which E. L. Doheny is president, is one of the finest examples of design and operation in California. It is the largest gasoline absorption plant built in unit in the Coast area, with a capacity rated at 100 million cubic feet of wet gas input per day. The plant was constructed in 1930 by Foster Wheeler Corporation and designed by W. L. Rifenberick of that organization. As much as 110,000 gallons of finished, stabilized natural gasoline has been turned out in a 24-hour period.

Location of the plant is on the Felix property on the North Dome of Kettleman Hills, bordering the western rim of the famous San Joaquin Valley. Materials used in construction were hauled by truck over specially constructed roads through the high hills, a notable accomplishment in itself. Another obstacle overcome was the lack of water at or near the site of construction, making it necessary for the company to purchase land in the floor of the valley for water production. Two wells 600 feet deep were drilled; a modern pumping station was installed which pumps the flow through six-inch pipe a distance of six miles into the hills. A more prolific water level than expected was encountered and the owning company now sells to other Kettleman Hills operators for drilling purposes sufficient water to return a sizeable income.

The plant proper consists of two units of 50,000,000 cubic feet of gas per day capacity, a 75,000-gallon stabilizer, boiler plant, cooling tower and storage. It is laid out in two saright lines with control board and instruments centrally located, so one operator can see from this point what is going on all over the plant. All control and shut-off valves are on the pump side of the distillation unit, and all valves in the entire plant can be controlled from the ground. Such valves on the steam and vapor lines are equipped with chain wheels to permit of this operation.

The boiler plant consists of five 150 H.P. boilers, equipped with water walls and super-heaters. The boilers have considerably larger combustion chambers than would be the case in those not equipped with water walls. The function of the water walls is to reduce the furnace temperature by absorption of heat from the hot gases and to generate steam, as well as to protect the fire walls. The purpose of the super-heat is reduction of pump water rate, as all pumps except gasoline shipping and stabilizer pumps, are turbine operated and from the pump exhausts the still super-heat steam is introduced into the still for reduction purposes—being preferred to wet steam as a means of reducing emulsion tendencies. This plant when treating 100 million cubic feet of gas per day at 450 pounds pressure, circulating 670,000 gallons of absorption oil and stabilizing 75,000 gallons of gasoline will require 47,875 pounds of steam per hour or 1600 boiler H.P.; this on the basis of all pumps operating on 38,375 pounds of steam or 1280 H.P. if water pumps, stabilizer pumps and shipping pumps are running on gas. The pumps are normally operated with gas, although all pumps are equipped to operate on either steam or gas or a mixture of both.

The primary pumping equipment consists of a turbine-driven high pressure lean oil pump, a low hot pressure lean oil pump and a gasoline reflux pump, the turbine taking steam at 145 pounds and 125 F. super-heat. It exhausts steam at 35 pounds and 19 F. super-heat. The exhaust goes partly to the still, as noted before, the balance to the gas heater, which heats the gas driving the gas operated turbines and all surplus to the exhaust steam condenser at the bottom portion of the cooling tower. The pumps were installed to operate on gas as well as steam so as to relieve the boiler load whenever possible, and to effect a saving of steam. In the operation of the plant it has been found that, with gas at 185 pounds, the turbines can operate with equal efficiency with two, three or four nozzles and reversing chambers. It was found they will not operate satisfactorily with only one nozzle.

The gas operated turbines showed no corrosion or erosion after several months' operation, the Kettleman Hills gas being sweet.

The absorber unit consists of nine absorbers, two still and a stabilizer, with necessary dehydrators, condensers, exchangers, etc. Interesting in connection with the exchangers is the fact that unusually high heat transfer rates are obtained with low pressure drops. Figure 1 gives the heat transfer in the various exchanger equipment in the plant. The pressure drop on the lean oil side of the exchanger is 11 pounds in the

California's Largest Gasoline Plants

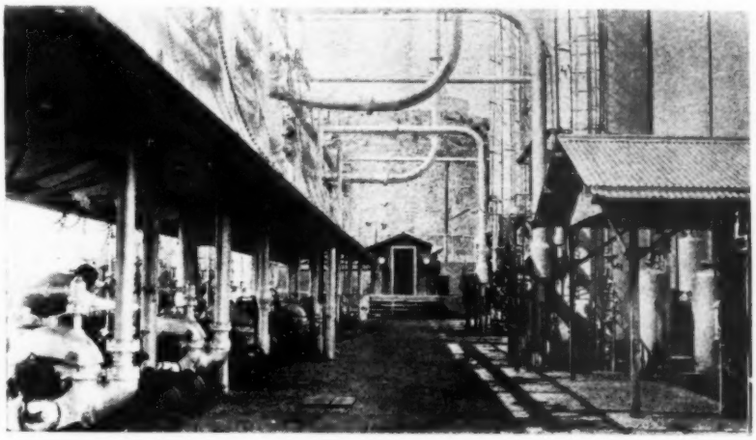
V. NEW

pressure heat exchanger and 10 pounds in the gravity exchanger. The pressure reduction in the fat oil side of the gravity exchanger and pre-heater is considerably higher due to the considerable amount of condensed vapors in the pressure heat exchanger. One heat exchanger can be bypassed and the plant normally operated. Experimentation along this line showed oil to the towers with temperatue of only about four degrees higher.

The absorbers and stills are designed with a view to allow maximum accessibility. Both have flanged heads and vapor lines connected at the sides which permit removal of heads and trays without disturbing the piping. The internal heaters placed at the bottoms of the stills can also be removed to allow cleaning without disturbing piping or shutting down the tower. The heaters are straight tube type submerged in the oil on the trays covering the bubble caps. The oil head on the trays is increased only three inches more than usual where internal heaters or coolers are employed. As the oil flows across the bubble caps on the trays and then through the heater coil the temperature is raised by steam passing through the tubes. Steel tubes, bare, are used in this plant, temperature of the steam being 525 degrees F.

The products taken off the stills show unusually close fractionation. Figure 1 shows distillation range of such products, and reflects the use of heavy gasoline as a refluxing agent. The oils run were filtered to remove any traces of moisture which might give false evaluations. Figure 2 offers a full explanation of the temperature increases of the oil as it progresses down the absorber. It will be noted that the fat oil temperature is maintained at a low point, as well as a relatively low lean oil temperature, and the operators of the unit have tabulated results supporting the theory that low lean oil temperature will permit more gasoline fractions to be carried from the absorber in the oil. Various gas-oil ratios results are given.

The stabilizer and kettle design are somewhat different from the conventional in that gasoline leaves the stabilizer and enters a horizontal kettle, the lower half of which contains heating tubes. The level of the gasoline is maintained at the area of maximum surface just above top of the tubes. This permits easy liberalization of vapors for return to the stabilizer. The gasoline passes out then through the heat exchanger and cooler and to storage.



Gasoline and Oil Pumps in the Los Nietos Plant

The water cooler is of conventional design, but contains, in the bottom, Foster Wheeler multipass atmospheric coolers. Any of these can be changed from single-pass to multipass by simply removing covers and inserting necessary baffles. Another feature permits of connecting inlet and outlet to any of six positions in the headers. Recently the installation was completed at a Fluor vertical side cooling tower, the first in California gasoline plants or oil refineries. It has been found that this tower effects a considerable water saving due to the location of the plant among wind swept hills. The wet bulb reading of this tower is reported to be .3 lower.

When the plant was put into operation it was run on .7 gallon gas at 450 pounds pressure. Due to a continual dropping of pressure in the Kettleman hills field operating changes have been made necessary. Present pressure shows a considerable reduction with accompanying increase of richness to 1.4 gallons.

There has been perfect ease of producing gasoline of 87.5 A.P.I. gravity and 96.5 per cent Engler recovery.

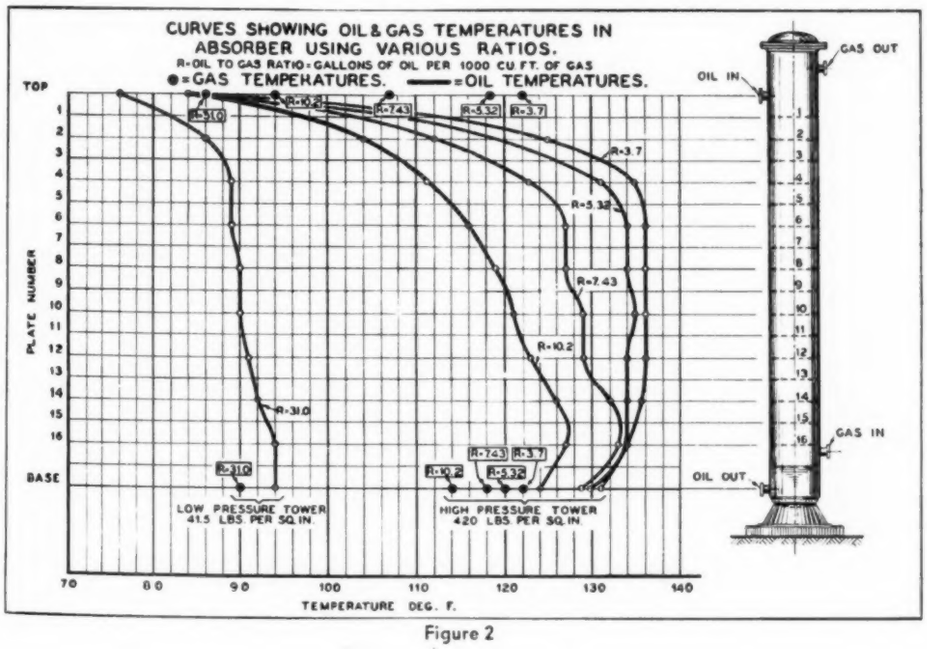


Figure 2

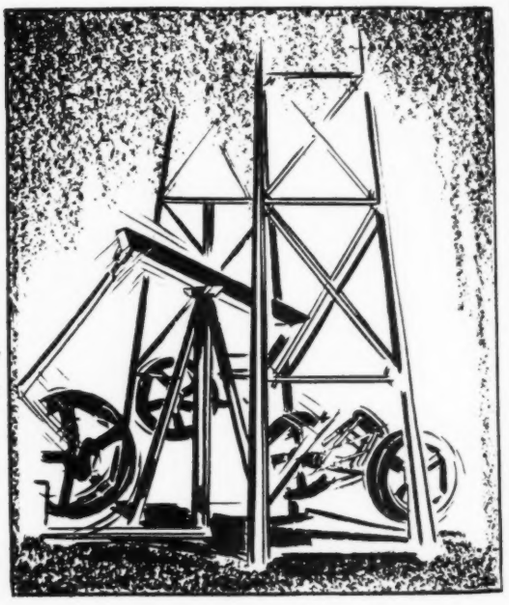
STRANGE.... *but* TRUE

HAPPENINGS IN THE PETROLEUM INDUSTRY

Forms of life were recently discovered in crude oil pumped from a depth of 8700 feet from a well in California. Bacteria, aptly described as veritable chemical laboratories, were found living in the crude oil.

Such a large amount of heat had been absorbed by the dirt surrounding the famous fire at the Romano-Americana well, Moreni, Roumania, that ten days after the fire was out and water had been poured continuously on the area the ground two feet below the surface was extremely hot.

While cutting the new channel for the Trinity river near Dallas a drag line bucket caught a 16-inch gas line carrying 150 pounds pressure, submerged in a few feet of water, and rippd it out. No explosion or fire followed when the gas roared skyward. A huge spray of water was blown upward and around the drag line and possibly the cooling effect of the water may have prevented ignition of the gas from the machine.



A pitman flew off the crank pin; the beam broke the headache post, smashed the driller's stool; and slid across the derrick floor to the bull wheel shaft. Nobody was hurt and the only damage was a broken saddle iron.

By B. H. LEONARD

INTERNATIONAL HARVESTER

Announces a New TRACTRACTOR

THE POWERFUL 6-CYLINDER

T-40

HERE comes a rugged new champion for the crawler tractor field. International Harvester — world's largest tractor builder — announces the McCormick-Deering T-40 TracTracTor.

The powerful T-40 gives you a 5-speed unit with 6-cylinder power. It is by all odds the most accessible crawler tractor on the market. Steering clutches can be inspected adjusted, or replaced through rear cover plates without disturbing track, track frame, or driving sprocket. Other parts are equally accessible, making for surprisingly low miantenance cost. Special dust seals guard every shaft and bearing. Backed by International Harvester nation-wide service.

We extend a cordial invitation to oil field operators, pipe-line contractors, and all heavy-duty tractor operators to get full particulars on the T-40. Consult any International branch or McCormick-Deering industrial tractor distributor, or write us direct.

INTERNATIONAL HARVESTER COMPANY
606 So. Michigan Ave. OF AMERICA (*Incorporated*) Chicago, Illinois

Brief Facts: The heavy-duty 6-cylinder engine is of valve-in-head design, with removable cylinders. High-pressure lubrication to all main, connecting-rod, wrist-pin, camshaft, and rocker-arm shaft bearings; no pipes to come loose. Thermostatically-controlled cooling. Oil-type air cleaner. Oil filter. Three-point mounting.

Forty-four ball bearings are used in the T-40 to reduce friction and avoid power loss.

The track frame, rollers, sprocket, and idler are of scientifically-treated steel alloys. The track rollers have unusually large bearing surfaces. The bearings are fully protected from dirt by self-adjusting oil seals and felt washers. The roller shafts and thrust bearings are submerged in oil.

Efficient, quick steering is provided through two dual-plate steering clutches located in the rear compartment of the frame.

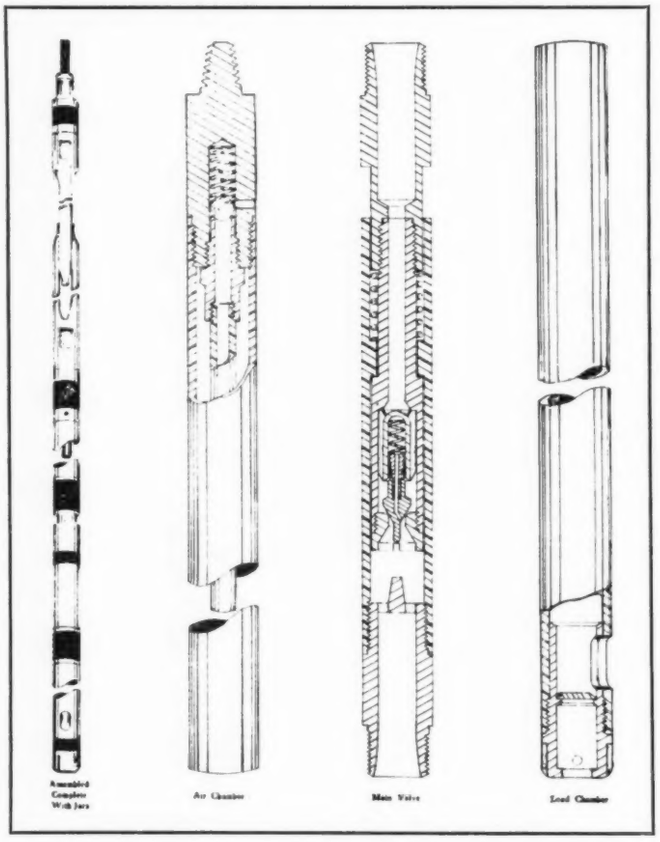
McCORMICK-DEERING

New Clean-Out Tool Attracts Attention

MID-CONTINENT operators are displaying considerable interest in methods of cleaning out producing wells, in which connection the use of new type suction bailers or pumps are being given a great deal of attention. A reason for this interest is probably the fact that there has been little remedial work done for the past 18 months, due to the costs involved and the low price of crude, but the only accessories necessary for running these new bailers is a sand line, a few hand tools, and a portable hoist, while the time involved is not great. For several years, sand pumps of improved design have been used in California fields for cleaning out wells with remarkable success, but in the Mid-Continent fields their use has been restricted.

The improved mechanical features of these bailers are important achievements and have greatly simplified cleaning out work. One particular device, the Smith Hydrostatic Sand Pump, has as its principle of operation, the carrying of a volume of air at atmospheric pressure, sealed by means of a valve, with a tube below, into which the fluid may enter and come up to the valve; thereby creating a fluid plunger.

When this clean-out tool strikes the bottom of the well, or material to be removed, the valve is automatically opened, permitting fluid in the lower tube to rush through the valve and compress the air to a small volume. The function is instantaneous and the transfer powerful enough to pick up hard sand, millings, pieces of iron and to clean perforations, and pull sand that is in the way of oil migration in from outside of perforation.



The pump itself consists of three major sections, the bottom, which is attached to a 20-foot tubular section, comprises the loading tube; a safety valve, head and syphon tube attached to another 20-foot tubular section comprises the upper or suction tube; the main valve, which is machined from solid alloy steel, is approximately three feet in length and is screwed between the suction tube and the load tube as the middle section. For safety, the device is run with suitable jars.

The successful operation of this pump can be attributed to the valve mechanism. This valve controls the entry of the fluid into the suction tube and it is always closed, except when the device is set on bottom, or when it is set on the rig floor for dumping purposes, then the upper section of the main valve is telescoped until the tip of the valve itself comes in contact with the riser on the lower section of the main valve, which raises the valve off its seat. The valve itself is fitted into a thimble in which there is a spring, while in the upper section of the valve is a piston upon which is placed cup leathers. This valve is drilled to allow the pressure from the load tube to gather behind the cup leathers, so as to equalize the pressure behind the valve to that below it, then the only force necessary to overcome when the valve is tripped is that downward force exerted by the little spring within the thimble.

The pump is run on a sand line to the bottom of the well and, of course, the fluid occupies the load tube at whatever hydrostatic pressure is at that point. The suction tube, being separated from the load tube by the main valve, contains only air at atmospheric pressure.

Several operating companies on the West Coast have found it effects a great saving in time and accomplishes fine cleaning out results. On one well at Santa Fe Springs, trouble was being experienced in cleaning out below nine feet of bottom. There was a 4⅜-in. liner in the hole, but after running the 2⅜-in. Smith sand pump for six hours the old original bottom was reached, perforations were well cleaned and the production of the well increased about 10 per cent. Another well, this one at Signal Hill, had to be cleaned out every 30 to 40 days, but after using this device it was still on production after 50 days.

In preparing another well for a cement plug a water-witch was run to locate the point of entry, a wooden plug was set, then the sand pump run to thoroughly clean out the mud from back of the perforations, Baroid and Aquagel were then dumped on top of the plug and after setting 24 hours, a regular bailer was run and it was determined at exactly what point the water was entering. After cleaning out the Baroid and Aquagel with the sand pump, the cement was dumped at the proper level—thus effecting a very successful water shut-off. (For this type of work the bottom of the pump was blanked off and the fluid entered through the side openings).

Recently, this pump has been used in several areas of the Mid-Continent, including several successful jobs in the Oklahoma City high pressure area. These operations were principally in the form of tests, conducted under the supervision of E. L. Decker of Martin-Decker Corporation, which concern is manufacturing and marketing the device. These tests, when completed, will furnish the Mid-Continent operators with some interesting data on the performance of the Smith Pump in this particular locality. The tests have been made in different regions of the Mid-Continent, under varying conditions.

New Method of Applying Insulation to Oilfield Boilers

STEAM economy has become an important factor in drilling because of the increasing steam consumption on wells with depth. As a result, more attention is being focused on the application of insulation to oil field boilers, a practice that has proven itself a highly economical measure and is now being adopted on a greater number of boilers than at any previous time.

The many advantages of the insulation of steam equipment are well recognized. One of the most important results of insulating is a reduction in radiation losses. This means a considerable saving in the amount of steam needed to operate a rig which, in turn, brings about a large saving in boiler fuel.

By insulating oil field boilers a drier steam is produced. Dry steam does not dissipate its heat as readily as saturated steam and is also easier on the operation of rig equipment, because there is less condensation in lines and steam cylinders than is the case with saturated steam. When dry steam is generated, steadier steaming is possible, there is less forcing of the boilers, less water is used, hence less scale is formed.

The necessity for drilling contractors to find some means of eliminating high steam costs on deep wells is shown by the tremendous losses from uninsulated steam equipment. For instance, a bare boiler with surface temperature of 180 degrees F., will lose by radiation heat equivalent to 718 cubic feet of gas each 24 hours per 100 square feet of surface. The average boiler has 400 square feet of surface, which means that the loss of gas, if it is used for fuel, will be 2,872 cubic feet per boiler per 24 hours. Since the average deep well uses three or four boilers the tremendous importance of reducing this great loss is easily recognized. Table No. 1 shows the heat losses on uninsulated steam equipment, as gathered from tests made in the field.

Heat losses are materially increased beyond those quoted should there be a wind blowing. With a 12½-mile-an-hour wind blowing (Table No. 2) the loss becomes 3,159 cubic feet of gas per 24 hours per 100 square feet of surface, or approximately 12,636 cubic feet per boiler. Insulation of boilers causes a material reduction in the effect of windage factors on convection of steam.

Of particular interest is the recent insulation of three boilers of a battery of four on a well Hugh Hodges, drilling contractor, is drilling for the Producers & Refiners Corporation in the Oklahoma City field. Field men have displayed considerable interest in the method of insulating used, as it is of a new type and design.

The outstanding feature of the insulation in use in this instance is its sectional construction. The lagging is of blue annealed steel, 22-gauge, and is lined with a two-inch layer of Eagle-Pitcher mineral wool. It comes shipped in sections and is applied simply by clipping the sections of steel lagging together, and is easily removable.

This method of applying the insulation has many advantages, including ready access to any part of the boiler for repairs as well as ease of handling when changing locations. Both of these features are important. The advantages of the former can readily be realized, while in the latter, damage to the insulation material during moving operations is prevented, for the ease of removing and applying it makes it sufficiently desirable and economical to remove the sections then reapply them upon reaching the new location. In this way the lagging and insulation are expected to last throughout the drilling of many wells.

The insulation with the steel lagging, known as the steel jacketed boiler insulation cover, is marketed by Lucey Products Corporation. It is not applied directly against the boiler plate, but has a space of three-fourths of an inch between the boiler shell and insulation itself, thus the possibility of injury to the boiler shell by unobserved leaks is practically eliminated.

Mr. Hodges has found that it takes about two hours longer for the boilers to cool off when shut down when they are insulated. This makes for a reduction in boiler maintenance cost as sudden contractions and expansions of the boiler are prevented, an action that has a damaging effect on boilers.

Table No. 1

HEAT LOSSES FROM FLAT BARE IRON SURFACES . . STEAM AND DIRECT HEATED

Air at 70 Degrees F., Gas 1,000 B. T. U. per Cu. Ft., Boiler Efficiency 70%

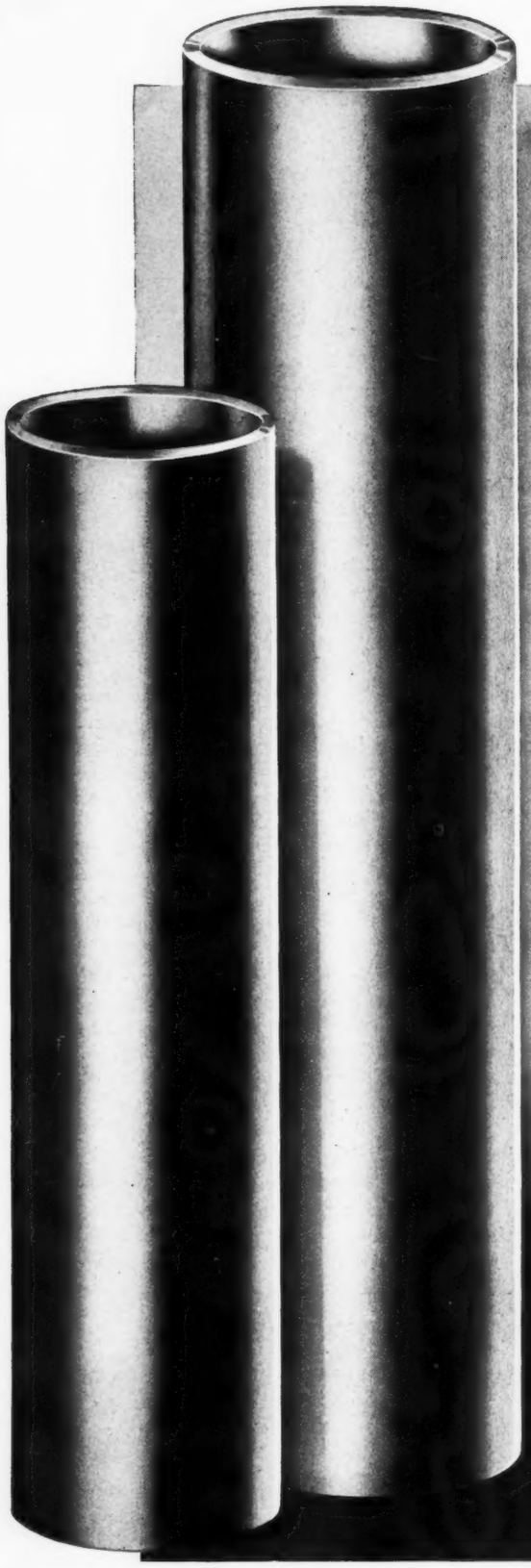
Actual Surface Temp.	B. T. U Lost per 100 Sq. Ft. per 24 Hours	Cubic Feet Gas Wasted per 24 Hours per 100 Square Feet	
		From Steam Heated Surfaces	From Fire Heated Surfaces
120	192,000	281	187
170	456,000	655	568
180	516,000	718	530
239	900,000	1280	905
270	1,150,000	1620	1153
324	1,643,000	2340	1654
350	1,935,000	2746	1905
370	2,153,000	3089	2186
387	2,359,000	3370	2373
420*	2,790,000	4368	2808
470*	3,550,000	5019	3523
488*	3,815,000	5460	3805
520	4,385,000	6292	4430
570	5,420,000	7799	5428
620	6,475,000	8892	6240
670	7,750,000	11079	7800

*Approximate: Allows for temperature drop from pipe to steam.

Table No. 2

EFFECT OF WIND ON HEAT LOSSES FROM BARE FLAT IRON SURFACES

Surface Temperature Degrees F.	Number Times Heat Losses Increased by Wind Velocity, Miles Per Hour					
	1	2½	5	7½	10	12½
120	1.6	2.1	2.7	3.2	3.6	3.9
170	1.7	2.3	3.0	3.6	4.0	4.4
270	1.6	2.2	2.8	3.4	3.7	4.1
370	1.5	2.0	2.6	3.1	3.4	3.7
470	1.5	1.9	2.4	2.8	3.0	3.3
570	1.4	1.7	2.1	2.4	2.7	2.9
670	1.3	1.5	1.8	2.1	2.3	2.5



NATIONAL USS STAINLESS AND HEAT RESISTING PIPE AND TUBES

This superior tubular material offers these outstanding advantages:

- High resistance to corrosion.
- Maximum strength at high temperatures.
- Unusual resistance to oxidation or scaling.
- Dependable uniformity in structure, in strength and in quality.
- Accurate, controlled heat treatment.
- Exceptional ductility.
- Seamless—no welds.
- Widest range of diameters, wall-thicknesses and lengths.
- Furnished with plain, upset, or otherwise formed ends.
- Large assortment of sizes in stock for immediate shipment.
- Sentry drilled (when ordered)—an exclusive patented feature.

The high quality and general adaptability of these exceptional tubes make them particularly attractive from the standpoint of both economy and durability. They are especially recommended for cracking tubes and for piping in heat exchangers, ducts, containers, tanks, agitators and other refining equipment where hot oil is handled.

NATIONAL Engineers and Metallurgists will gladly lend their aid in determining the best application of stainless and heat resisting pipe and tubes to your particular requirements.

U S S Chromium-Nickel Alloy Steels are produced under the licenses of the Chemical Foundation, Inc., New York, and Fried. Krupp A. G. of Germany.

NATIONAL TUBE COMPANY

Frick Building, Pittsburgh, Pa.

QUALITY PRODUCTS — Dependable Service

SUBSIDIARY OF UNITED STATES STEEL CORPORATION

PRINCIPAL SUBSIDIARY MANUFACTURING COMPANIES

AMERICAN BRIDGE COMPANY
AMERICAN SHEET AND TIN PLATE COMPANY
AMERICAN STEEL AND WIRE COMPANY
CARNEGIE STEEL COMPANY
COLUMBIA STEEL COMPANY
CYCLONE FENCE COMPANY
FEDERAL SHIPBUILDING AND DRY DOCK COMPANY
ILLINOIS STEEL COMPANY
NATIONAL TUBE COMPANY
OIL WELL SUPPLY COMPANY
THE LORAIN STEEL COMPANY
TENNESSEE COAL, IRON & R. R. COMPANY
UNIVERSAL ATLAS CEMENT COMPANY

Pacific Coast Distributors—Columbia Steel Company, Russ Building, San Francisco, Calif. *Export Distributors*—United States Steel Products Company, 30 Church Street, New York, N. Y.

Furnace Wall Construction

By GEO. P. RENTJES☆

WHY is it the fire brick which has given you such good service for so many years was a complete failure in your new furnace? Is it because the manufacturer does not have as good a quality of clays, because he now has less knowledge of how to manufacture brick, or has poorer equipment than formerly? No. The cause most frequently lies in the design of walls and gas travel.

The ever-increasing size of furnaces and rates of combustion call for more thought on your part, in designing the furnace walls.

The individual manufacturers of refractories, the American Refractories Institute, and the Department of Commerce, co-operating with each other, have and are spending thousands of dollars in developing better refractories. As mentioned in a previous article, their function ceases with the manufacture of the brick. To you is left the problem of installation. How have you handled these problems? Have you in turn delegated this responsibility to a plant handy man?

You can save your company many dollars in fuel savings, as well as in furnace maintenance, by studying these suggestions.

The walls and floors should be designed to facilitate the delivery of the gases heated by combustion to the product to be heated, with the least possible interference. Any interference with this flow causes a pressure or a retort action within the furnace, and the consequent overheating of the walls. The trend to higher settings, more efficient burning equipment, and hotter gases, accentuates this problem. In many furnaces there is too small a factor of safety between the furnace operating temperature and the softening point of the brick walls, especially in the corners and near the floor line.

It has been repeatedly proven that the corners of a furnace are hotter than the side walls, and the walls at the floor line are hotter than that portion of the walls near the tubes. The reasons are: First, radiant heat is reflected from one corner to the other; second, the flow of gases is restricted by the corners just the same as water flowing through a square pipe or gases through a square stack; third, the gases will eddy in the corner, carrying heat to be absorbed by the walls.

Examine your oil or gas-fired boilers and you will see that more erosion has occurred at the corners than in the side walls. You will also note that the fire brick near the floor line have deformed, and as a result there is a separation of the upper and lower wall lining near the first row of tubes. The upper portion of the side wall is resting on the tubes. This condition is a severe strain on the boiler tubes as well as causing an excessive amount of air leakage through the walls. This tends not only to cool the tubes, but also to bottle the hot gases in the furnace.

If you have this condition at your plant, do not blame the refractory manufacturers, saying their refractories will not stand up under the load of the wall at your furnace operating temperatures. As a matter of fact, no one knows what pressures have been applied to the deformed brick. I am referring to walls consisting of a combination of red brick and fire brick, the two types of materials being bonded together. The exterior, or common brick, are laid in cement mortar. The inner brick, being hotter, have the greater expansion.

Because of the headers tying the wall together, the expanded fire brick not only must support the upper wall, but must also withstand the pressure of breaking the cement joints between the red brick. If it requires less pressure to shear the headers than it does to break the mortar joints, the wall is divided longitudinally into two parts, and you will not have horizontal cracks in the outer wall. If you fail to find horizontal cracks in your brick work where the mortar joints have been sheared, you may be assured that the headers within the wall are broken.

The average Missouri refractory will deform 10 per cent at 2700° F. under a pressure of 25 pounds to the square inch. The weight to be sustained by your refractories, when expanded, is the pressure required to shear the headers, plus the weight of the wall above. We can conclude from the above: First, that it is a false economy to use red brick and fire brick in a boiler or still wall; second, the weight of the upper portion of the wall should not be carried by the lower portion; third, means should be provided for independent expansion of both sections; fourth, the floor should be so designed that the gases are turned upward toward the tubes, without eddying or friction loss. With these thoughts in mind, wherever possible we have recommended the elimination of red brick in furnace settings.

A hanging wall, as shown in Figure 1, has been developed. You will note that this wall can be built either air-cooled or solid. In a battery setting, the dividing wall should be air-cooled—the outside walls may be built solid. By air-cooling the center or dividing wall, you can work in one of the furnaces while the other is under fire. The upper portion is lightened and at the same time built to the width required by the boiler spacing.

In both air-cooled and solid walls, the vertical expansion is

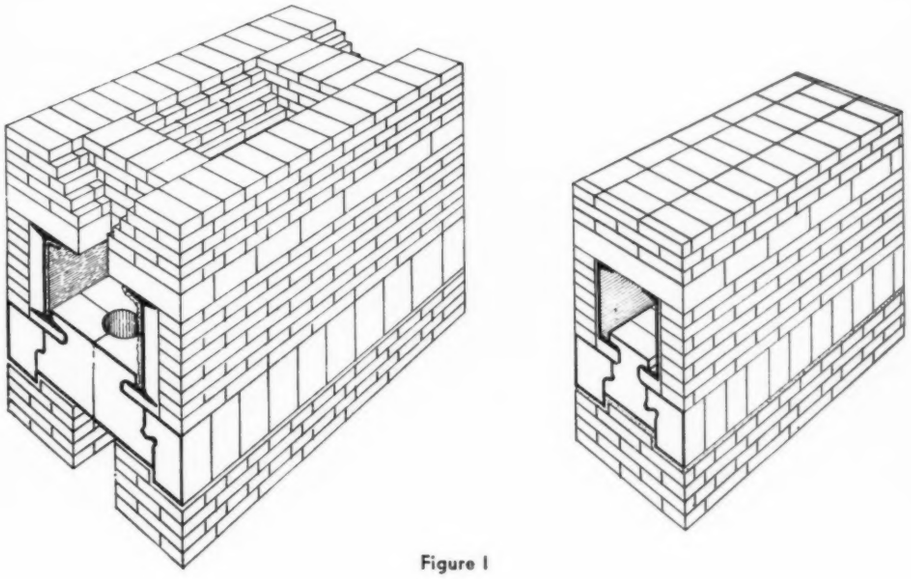


Figure 1

☆Geo. P. Rentjes Co.

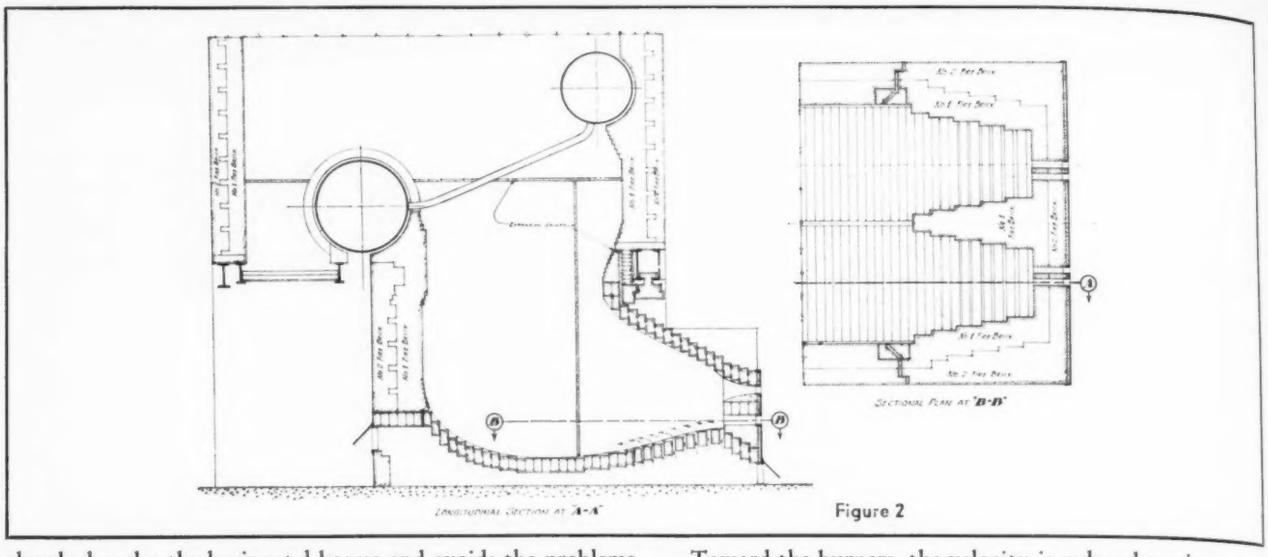


Figure 2

absorbed under the horizontal beams and avoids the problems brought about by the accumulated expansion of the total wall height. By using this construction you can take out and replace the entire lower portion of the wall without disturbing the upper structure. Where you are confronted with the problem of too small a combusion space in the furnace you can build narrower side walls below the supporting beam and increase the boiler furnace width as much as 18 inches wider than the boiler tubes.

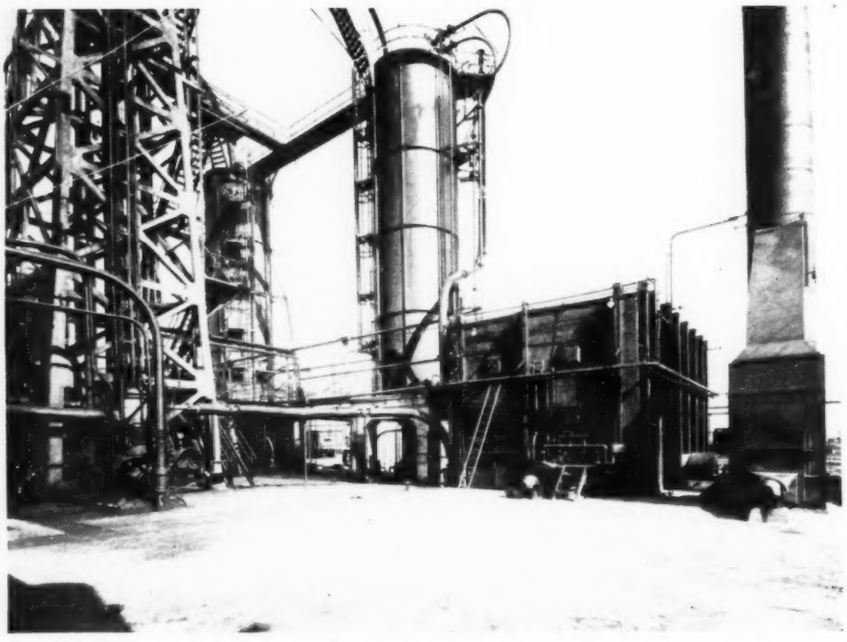
Increasing the furnace width in this manner will reduce the amount of B. T. U. liberation per cubic foot of furnace volume as much as 15 per cent, and still release the same amount of heat as formerly. There is a marked relation between the B. T. U.'s liberated per cubic foot of furnace volume, compared with the facility with which they can be readily absorbed by the tubes and the amount of heat that penetrates the walls.

Figure 2 is an ideal arrangement for curving the floor for stream line flow of the gases toward the tubes. The refractory floor should be of sufficient thickness to reflect radiant heat to the expanding gases. This design of floor contour will give a modified Venturi type air passage beneath, which increases the air flow at the point where the flame is hottest and where there is the most danger of the heat penetrating and endangering the foundations.

Toward the burners, the velocity is reduced to give a more uniform distribution of combustion air through the floor to the fuel. An individual Dutch oven is used for each burner to take advantage of sidewall radiant heat. By raising the arch as it extends inward, increasing the cross-sectional area of the Dutch oven, the walls do not absorb an unnecessary amount of heat from the expanding gases.

We can also conclude that the manufacturers of refractories are doing their utmost to make better refractories, individually through their association, and with the assistance of the Department of Commerce; the furnace mason contractors are individually, in accordance with their respective ability, trying to improve the furnace wall structures; and that the combustion engineers are making remarkable strides in designing furnaces with the proper furnace volumes, also in selecting the proper types of burning equipment to obtain the desired results.

Most industrial corporations have learned that economy in furnace operation is dependent upon the proper coördination of the combustion engineer, manufacturers of refractories, fuel burning equipment, and mason contractors. There are still some industrial corporations leaving the matter in the hands of subordinates or to the prejudice of their plant handymen.



Mud Plug Seals Gasoline Line During Welding Repair

WHEN one of the Mid-Continent gasoline transporters had to cut an eight-inch welded line to remove a scrapper, the dangerous fire hazard caused the division superintendent to order temporary repairs until the company's most experienced welder visited the division. The temporary repair was made by joining the line by means of a sleeve type coupling.

No difficulty was experienced with this method of repair; however, this spring, the expert welder was available and it was decided to make the welded repair. The work was extremely interesting because of the methods employed to overcome obstacles which materially handicapped the welder in his work.

It was impractical to flush the line with water to remove the volatile substances because of a limited water supply at the station on the upstream side of the repair job's location. It was then decided to close the nearest block gates on both sides of the repair, drain the line and then flush it with water pumped from a near-by stream by means of a pick-up unit.

The pipe was stripped back a few feet on each side of the repair and a bell hole made to facilitate work at the joint. A drain ditch was cut leading from the bell hole to an earthen reservoir. The line was parted and most of the gasoline was caught in the reservoir. Because the job was close to a highway and near storage, the gasoline was pumped into tank wagons and transported to storage, saving considerable loss of gasoline which otherwise would have been burned. After all the gasoline had been recovered and most of that which had saturated the ground had evaporated, the bell hole and reservoir were fired. When the brief-burning fire died down, sand was thrown into the bottom of the bell hole.

The pick-up unit could not be used to a good advantage because it could not handle sufficient volume of water to purge the line of gasoline and gas. To add to the troubles of the repair crew one of the valves leaked slightly, adding to the volume held in the sags.

To go ahead with the repair it was decided to insert mud plugs in the two open ends of pipe, line them up and make the weld. One end of the line was raised on a tripod and the other left in its normal position. A heavy sticky clay was moistened enough to make it suitable for use. Mud was then shoved back into each length of pipe for a distance of approximately six feet. With both plugs in the line the suspended length of pipe was lowered. Expansion had taken place during the morning and it was necessary to drive the pipe into alignment.

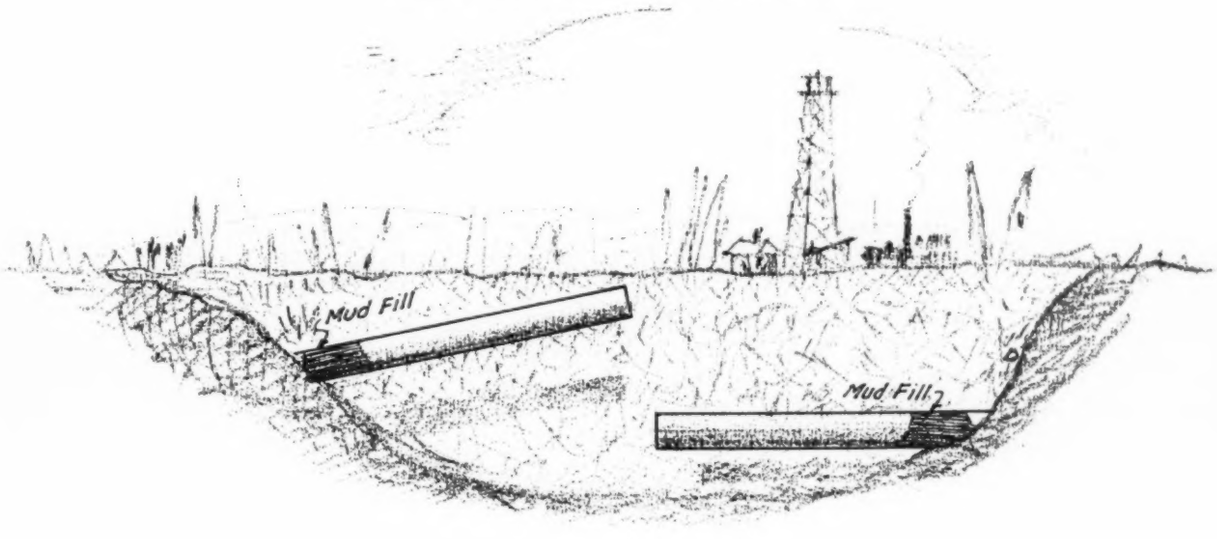
With the pipe in alignment the welder started the bell hole acetylene weld. In the mean time, crew members soaked strips of canvass in water to be used in the event of fire. When the weld was 50 per cent complete gas broke through one of the mud plugs and a small flash followed. The welder was on the alert for such a happening and was not burned. Crew members smothered the fire.

The line was then tapped at the nearest sag to bleed off the accumulated gasoline and gas. The line was again parted and the partially completed weld cut out with a cutting torch. Workmen reconditioned the mud plugs to make them gas tight. A suitable length nipple was cut from eight-inch pipe and welded to the raised section of the line. This section was lowered into the ditch and lined up perfectly and the bell hole welder made the tie-in weld without further trouble.

The tap made in the sag was left open during the welding process and permitted the gas leaking by the block gate to blow off into the air. This prevented too much pressure building up behind the mud plug and possibly breaking through.

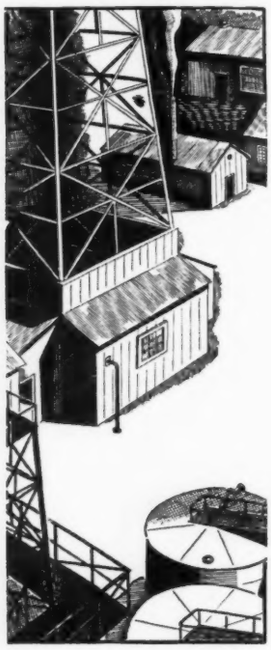
Upon completion of the work the tap was plugged and welded. When all welding had been completed the gate valves were opened and the station behind the repair started. As soon as pressure was built up in the line the mud plug was shoved on through to the receiving tank at the next station.

Drawing illustrating method of mud-plugging line



AMERICAN STEEL SHEETS

Specially Adapted to Oil Country Uses



KEYSTONE COPPER STEEL
AMERICAN
SHEET AND TIN PLATE COMPANY
PITTSBURGH
TRADE MARK REG. U.S. PAT. OFF.

KEYSTONE

Rust Resisting Copper Steel Sheets

FOR

Tanks, Barrels, Drums,

AND FOR ROOFING AND SIDING

This copper steel alloy is used by prominent tank, barrel and drum manufacturers. APOLLO-KEYSTONE Galvanized Sheets are also specially adapted for shops, sheds, boiler and belt houses, and oil country construction.

AMERICAN products are carefully manufactured in every detail — both mechanically and metallurgically. This Company produces high grade sheets for all known purposes. Supplied in Black and Galvanized Sheets, Special Sheets, Tin and Terne Plates, etc. Sold by leading metal merchants.

We also manufacture

USS

STAINLESS
and Heat Resisting
STEEL SHEETS
AND LIGHT PLATES

American Sheet and Tin Plate Company

General Offices:
FRICK BUILDING, PITTSBURGH, PA.

Subsidiary of United States Steel Corporation

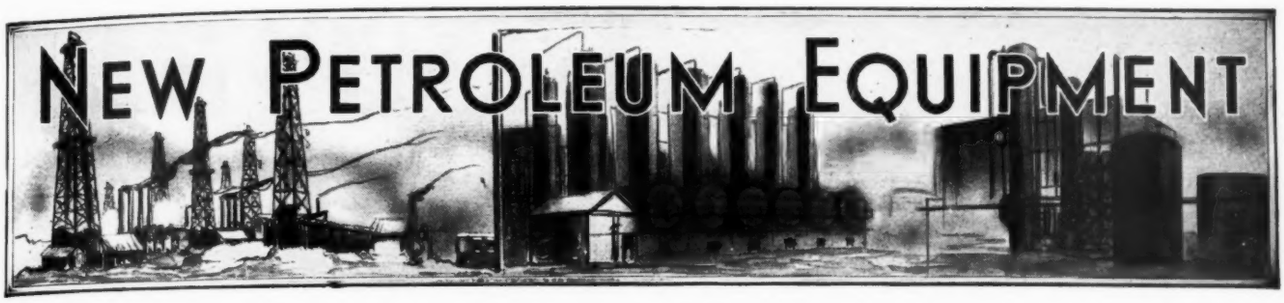
PRINCIPAL SUBSIDIARY MANUFACTURING COMPANIES:

AMERICAN BRIDGE COMPANY
AMERICAN SHEET AND TIN PLATE COMPANY
AMERICAN STEEL & WIRE COMPANY
FEDERAL SHIPB'LDG. & DRY DOCK COMPANY
CARNEGIE STEEL COMPANY
COLUMBIA STEEL COMPANY
CYCLONE FENCE COMPANY
ILLINOIS STEEL COMPANY
MINNESOTA STEEL COMPANY
NATIONAL TUBE COMPANY
OIL WELL SUPPLY COMPANY
THE LORAIN STEEL COMPANY
TENNESSEE COAL, IRON & R.R. COMPANY
UNIVERSAL ATLAS CEMENT COMPANY

USS STEEL

Pacific Coast Distributors—Columbia Steel Company, San Francisco, Calif.

Export Distributors—United States Steel Products Company, New York, N. Y.



Modern Type Beam Hanger

A NEW beam hanger that comprises a complete connection between the walking beam and the polished rod has just been introduced by the National Supply Companies. It is known as the National Type F Beam Hanger, and the design incorporates many new and important features.

An improved bearing connection is supplied, and this bearing is placed level with the center iron bearing. This minimizes deviation from a straight lift and furnishes a connection which can be moved readily to clear the well for pulling operations.

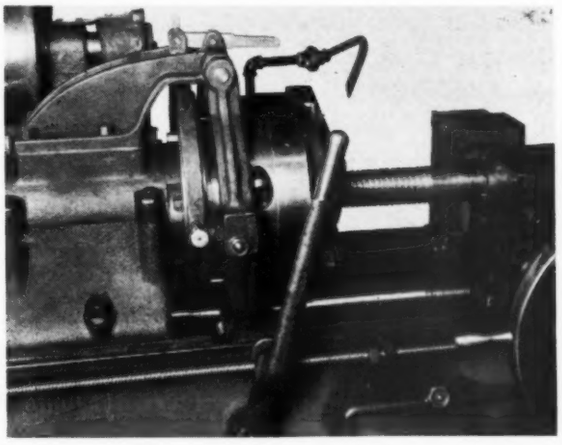
This hanger has the exclusive feature of locating entirely from the level top surface of the beam which is the only surface common to practically all makes and sizes of beams. It does not contact the back of the temper screw slot and is therefore independent of the various designs of this part. The hanger is simply fixed to the beam in measured relation to the center-line of the hole without fitting or adjustment.

The unusually large bearing permits practical low unit bearing pressures with even the heaviest pumping loads. The forged steel pin is turned, carburized, heat treated and ground to an accurate bearing surface. SAE 64 phosphorous bearing bronze is used for the bushing, which is made in one unbroken section for accuracy and efficient maintenance of the oil film. Enclosures retain the oil, exclude dirt and hold the assembly in correct relation.

Landis Four-Inch Rotary Die Head

A NEW die head having a capacity up to and including four inches diameter and equipped with a roughing and finishing attachment has been developed by the Landis Machine Company, Inc., of Waynesboro, Pa., for use on the Landis four-inch leadscrew threading machine.

The die head is recommended for cutting coarse pitch threads on valve stems, vise screws, jack screws and similar classes of work which require great accuracy and an exceptionally smooth finish.



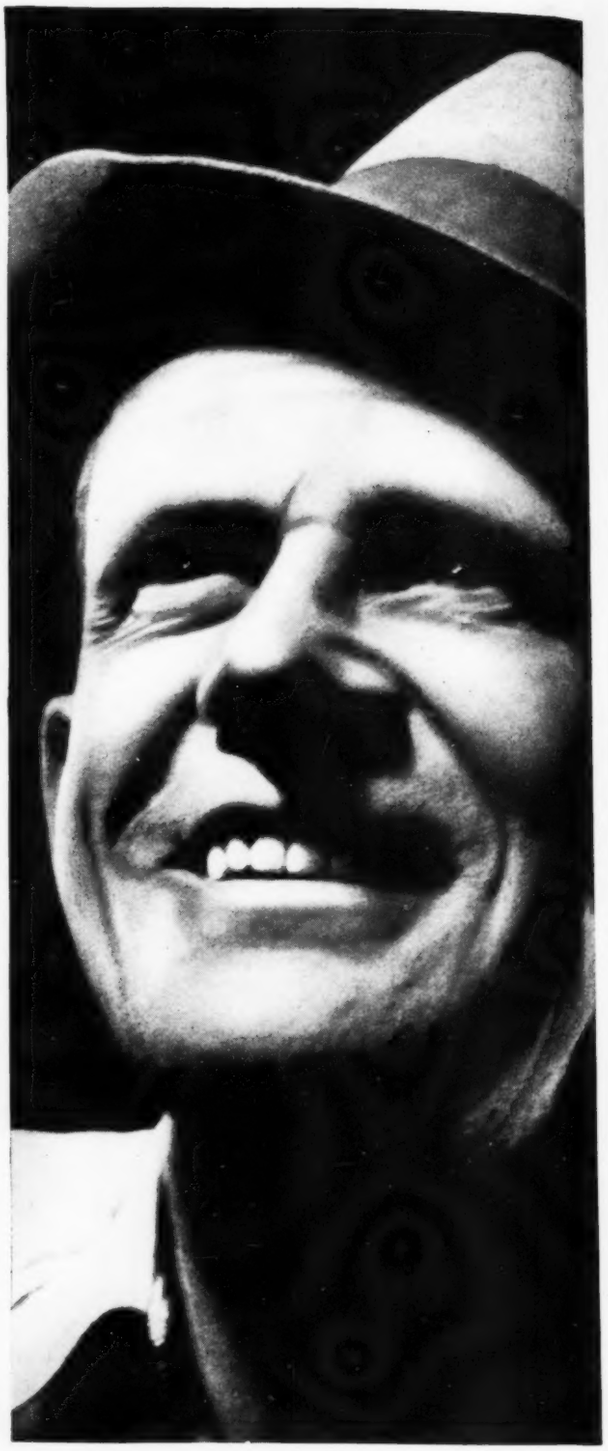
The roughing and finishing cuts are controlled by a latch mounted on the yoke bracket. The release of the latch, after the roughing cut is made, permits the die head to close for a light finishing cut. The amount of metal removed during this cut is approximately .045 of an inch.

No cutting strains are transmitted either to the die head yoke or the roughing and finishing attachment. The die head is locked within itself when set for either the roughing or finishing cut, thus making it possible to produce threads that are free from taper and uniformly accurate for size.

This die head can be used for cutting single, double, triple and quadruple threads from three-fourth of an inch to four inches in diameter with a maximum lead of one-half inch.

WHOOPEE!

We Cut Sucker Rod Costs 89% in West Texas!



ROD costs reduced from $6.89 to $1.10 a day—or from $13.31 to $1.34 a day! Those figures—taken from actual service records—are typical of what Reading Puddled Iron Sucker Rods are doing today to keep costs DOWN.

You'll SAVE with Reading Rods—save maintenance, labor and time. You'll keep your cost per barrel at a minimum, without the dragging expense of frequent rod breaks. Operators throughout the oil country are learning that PERFORMANCE—not promises—is what makes Reading Rods a paying investment on any lease.

Reading Rods are made of genuine PUDDLED iron—made with the superior skill and care that has kept Reading products at the fore-front through nearly a hundred years. Try out Reading Puddled Iron Sucker Rods in your own wells—compare them with others, point by point. Then you'll standardize on Reading!

READING IRON COMPANY
Philadelphia

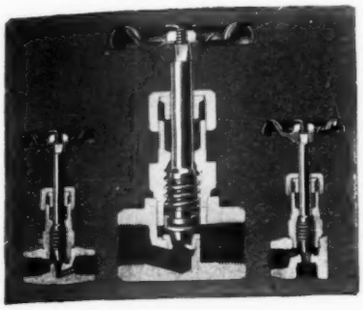
57 Years of Serving The Oil Industry

READING
PUDDLED IRON SUCKER RODS

Science and Invention Have Never Found a Satisfactory Substitute for Genuine Puddled Iron

Bar Stock Valves

THE Reading-Pratt & Cady Company, Inc., Bridgeport, Conn., now offers ¾-inch and one-inch globe valves, that are precision turned from high grade carbon steel—an addition to its regular line of bar stock valves.



The valves are recommended for all services where high strength and close control are desirable features. They have stainless steel, slip-on renewable discs and stainless steel screw-in seats. The stems are especially designed and treated for temperature service and resistance to corrosion. All other parts are Parkerized inside and out.

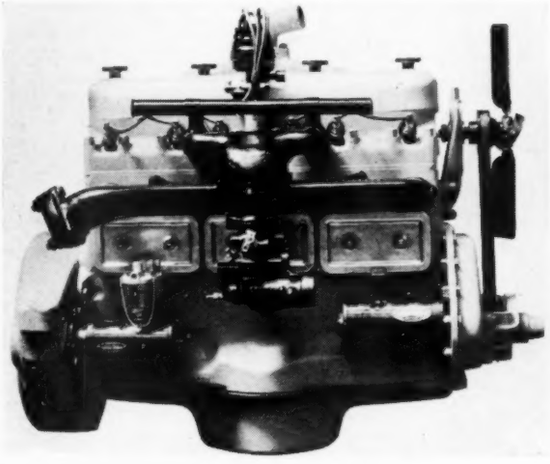
Smaller sized carbon steel valves, in both the globe and angle patterns, have integral seats and discs—otherwise they are similar to the larger valves. The working pressures are 4000-pounds at 150 degrees F., 600 pounds at 500 degrees F.

In addition to the standard line, the valves can be furnished with indicator handwheels, lock shield and key, male or female unions, and male or female ends. There is also a manifold type consisting of three valves on a single body.

Waukesha Full-Power Engines

WAUKESHA MOTOR COMPANY, Waukesha, Wis., has announced an entirely new line of engines of increased efficiency, smoother operation and longer life.

The new Waukesha Full-Power Engines are more conservatively rated than previous Waukesha products. This radical departure from common practice in manufacturer's power ratings makes it possible for the ordinary user to utilize his engine for all regular requirements without having to draw on the engine for its full capacity.



Under circumstances where the Full-Power Engine is called upon for hard work and a continuous output of its full horsepower, the hazard of short life has been overcome through a stiff structural design combined with the new materials, that were developed in the Waukesha Metallurgical Laboratory, and which, the manufacturer claims, actually increase power plant life over conventional designs in identical service.

Among the new materials used is Waukesha Alloy 221. It is a special cylinder iron with the hardness of chrome nickle steel and a tensile strength equal to machine steel. Microphotographs show it has a dense interlaced structure, is free of carbides and has uniform graphite distribution, with hardness of 250-280 brinell. It is also an exceptionally good conductor of heat.

Another new iron alloy developed is used in the exhaust manifolds of these engines. This is another low "growth" iron which enables gaskets to stand up and joints to stay tight, and practically eliminates manifold distortion. Improvements in the manifold design itself make the method of attachment to the cylinders simple and accessible, and permit controlled heat to the intake with either up or down-draft carburetors.

New bearing metals of great durability have been evolved and an improved technique in bearing manufacture has been found. This method entails special preparation of the steel surfaces of the bearing shells and connecting rods, which insures perfect bonding between the bearing metal and the shell or rod itself. The bearings are integral with the connecting rods and are cast from electrically controlled babbit pots by centrifugal casting machines.

Main bearings are made of the same material, bonded to steel backs, fitted with great precision into the crankcase bearing seats.

American-LaFrance Fire Extinguishers

TWO new fire extinguishers presenting new and radically advanced improvements have just been announced by the American-LaFrance and Foamite Corporation of Elmira, N. Y. The new models are known as the Foamite Crusader and the Childs model Ds. Both are of the 2½-gallon size.

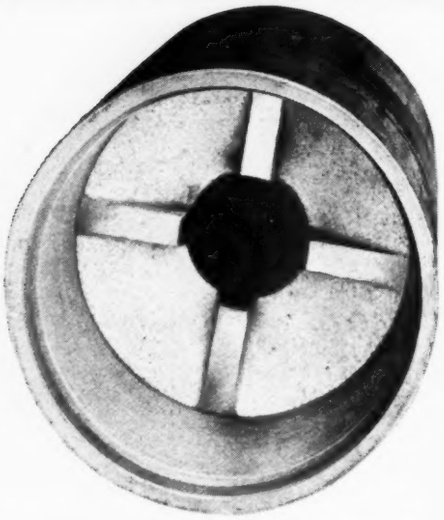
Principal among the advanced features incorporated in both of these new models is the Monotype construction. The entire dome and shell are drawn from a single sheet of special alloy known as Alfronze. There is no side seam, no dome seam.

Other vital features of this new line of fire extinguishers include: a new type of collar construction, which is hot-pressed to size in a die and is attached to the head of the extinguisher by a special process for which a patent has been applied.

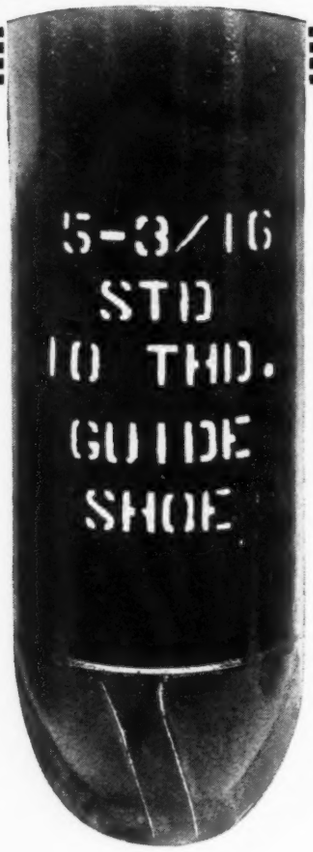
A special patented discharge screen is used on the Foamite Crusader, which the manufacturer claims produces firefoam the instant the device is inverted.

HALLIBURTON *floating* EQUIPMENT

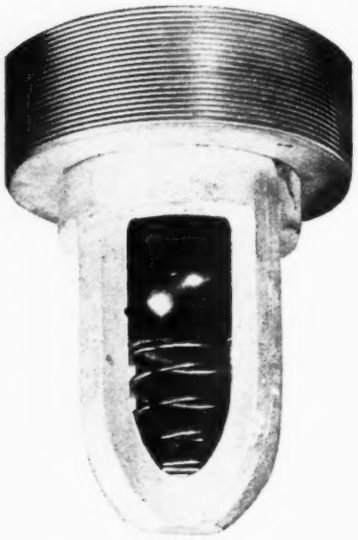
DESIGNED WITH THE VIEW OF ELIMINATING DIFFICULTIES WE HAVE EXPERIENCED IN MANY CEMENTING JOBS DURING THE PAST FEW YEARS ●



Openings and courses through the guides and back pressure valves permit free flow of cement.

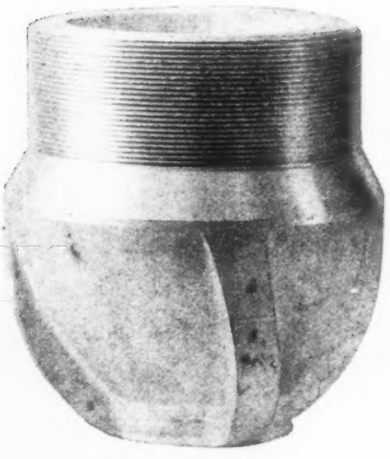


We assume all patent liability on any and all equipment manufactured and sold by us.



HALLIBURTON
BACK PRESSURE VALVE

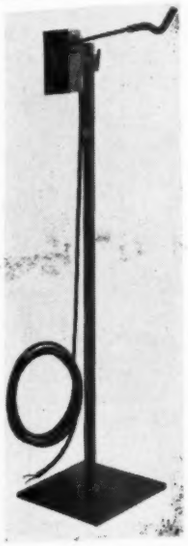
HALLIBURTON OIL WELL *Cementing* COMPANY
●
DUNCAN, OKLA.



HALLIBURTON
GUIDE

Lincoln Power Saver Electrode Holder

A NEW electrode holder that automatically shuts down the welder one minute after holder is placed on stand and instantly starts the welder when holder is removed is announced by the Lincoln Electric Company of Cleveland, Ohio.



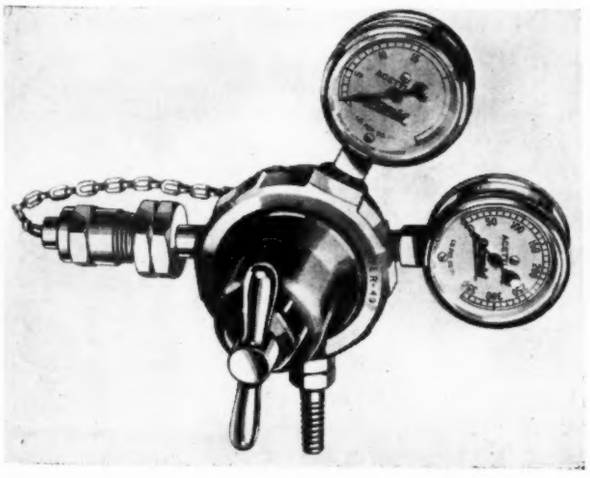
It is claimed that the automatic start-and-stop feature of the new stand effects a decided saving in power consumption. By shutting the machine down when the operator is not actually welding, power will be saved and the over-all power factor of the plant raised, since by shutting the machine down during idle times, it will at no time be operating at reduced power factor.

Operation of the stand is extremely simple. When the hook is depressed by the weight of the holder it activates a special timing device which, at the end of one minute, disconnects the welder from the power supply line. When the holder is removed from the hook the welder starts automatically.

The stand is of arc welded steel construction. Its broad, heavy case provides ample rigidity, yet does not impair its portability. The holder hook can be raised or lowered on the upright member to suit the convenience of the operator. Fifteen feet of rubber-covered, two conductor cable is provided with stand for connection to welder. The "Power Saver" can be used whenever the welding equipment is provided with an automatic motor starter having two wire pilot controls.

Linde Oxweld Regulators

THE Linde Air Products Company, 30 East 42nd St., New York City, has recently added two new regulators, the Oxweld Type R-48 Oxygen Regulator and the Oxweld Type R-49 Acetylene Regulator to its line of Oxweld welding and cutting apparatus. These new regulators have been designed to provide the Oxweld line of apparatus with a pair of lighter duty regulators, particularly for use with Oxweld Type W-15 Welding Blowpipe in the Oxweld Sheet Metal Welding Outfit.

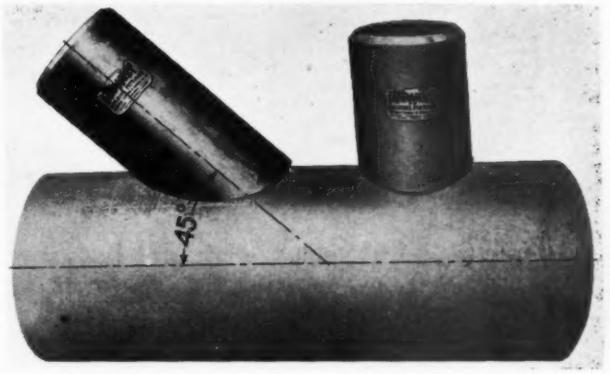


These new regulators of the sturdy stem type are most compact. The bonnet is held in place by a forged brass cap ring which assures a non-leaking diaphragm. Assembly and disassembly are facilitated by the ribbed cap ring which assures an easy grip.

The Monel metal stem is detached from the diaphragm, thus providing increased smoothness in the operation of the regulating mechanism. Pressure forgings are used in the body cap ring and pressure adjusting screw. This screw has a high thread pitch which permits rapid pressure adjustment.

Midwest Shaped Welding Nipples

THE Midwest Piping & Supply Company, Inc., of St. Louis, Mo., has recently placed on the market a line of Midwest shaped welding nipples which eliminate all templates when saddling one pipe upon another. The nipple is placed in position before the opening is cut in the pipe upon which it is to be saddled; the correct opening is then easily and quickly

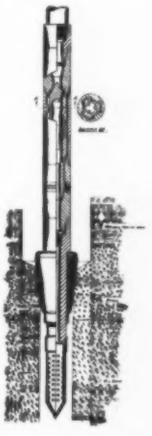


traced from the nipple contact line. As a result, the Midwest shaped welding nipples save time and money in addition to assuring an accurate fit. Both the shaped end and the square end are beveled for welding.

Midwest shaped nipples (both 90° and 45°) are regularly made from standard weight and extra heavy wrought steel pipe and genuine wrought iron pipe; sizes are from one and one-fourth-inch to twelve inches, inclusively. On special order they can be provided with any type of forged lap or flange. Other angles, lengths and sizes are also available on application.

Shaffer Drift Indicator

THE Santa Fé Springs, Calif. plant of the Shaffer Tool Works has recently developed the Shaffer Drift Indicator. This patented tool, which in reality is an automatic straight hole instrument, is run on the drill pipe above the bit or drill collar.



It is left on the string during all the drilling operation and according to the maker enables the operator to detect and correct crooked hole while drilling. It consists of a sub made of heat treated alloy steel in which is mounted a vale operated by a plumb bob. This plumb bob is free to swing in all directions. Below the plumb bob is a cup shaped pin.

The force of the circulation tends to close the valve, but if the hole is within the required limits of straightness the plumb bob hits the pin, thereby holding the valve off the seat so that circulation continues. When the hole is more than the desired degree off vertical the plumb bob will miss the pin and allow the valve to Close, thus shutting off circulation. To find out if the well is off vertical it is only necesary to stop the tools and circulate for a very brief period. If the hole is within the required limits of straightness circulation will go on as usual and drilling may be resumed.

Flexco Deep Well Belt Fastener

FLEXCO Deep Well Belt Fastener, an improved belt fastener, designed to carry the increasingly heavy load as oil wells go deeper, is the product of Flexible Steel Lacing Company, 4607-31 Lexington Street, Chicago, Ill.

The Flexco Fastener is quite powerful in construction, each plate consisting of an inner and outer section. The outer section is made of heavy gauge steel, die-formed and hardened to give reinforced rigidity. This section is spot welded to the inner section, offering maximum strength with a minimum of weight. Plates, bolts and nuts are rust-proofed. Testing up to 20,000 pounds on 12-inch A. P. I. specification belting, this fastener actually combines strength and light weight, producing a durable, dependable joint for the most severe service.

Lugs on the inner faces of the plates engage the belt and prevent the belt ends from working out of the fastener. Large curved flanges of the inner sections reduce friction in the belt ends between the plies, thus helping to prevent ply separation.

The bolts are five-eights of an inch in diameter with S. A. E. thread. They are made of high grade alloy steel and hardened to obtain the maximum strength. The nuts are hardened to prevent stripping of the threads and burring of the outer corners.

No. 17 Beaver Power Adapter

THE Borden Company, Warren, Ohio, has announced the manufacture and sale of a unique little device, known as the No. 17 Beaver Power Adapter. Generally speaking, the Beaver Power Adapter is a worm-driven die stock using interchangeable die heads to thread all sizes and kinds of pipe from one-half to two-inches. It is operated by means of a three-fourth-inch heavy duty electric drill or, if desired, a compressed air drill may be used.

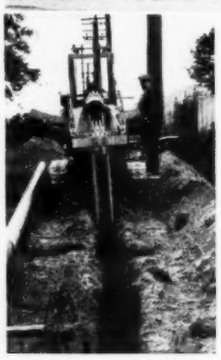
It is simple and practical with no delicate parts to get out of order. This adapter weighs no more than the ordinary die-stock (17½ pounds) and may be taken anywhere with you and one man can handle.

It is made of aluminum alloy construction. On the rear it has a self-centering chuck to hold it squarely and firmly on the pipe. On top, a convenient grip for easy handling. The double-ended drive enables the operator to cut right or left hand threads or to back off by power. A driving socket to fit electric or air drill chuck is supplied with each adapter for the net price of only $39.50.

Buckeye Traction Ditcher No. 12

WHEN the Buckeye Traction Ditcher Company, Findlay, Ohio, made their designs for the Model 12 Buckeye Wheel Type Service Ditcher, they designed for greater speed to handle the many jobs that call for ditching in cramped quarters or in open country.

Digging trench at the rate of a foot every six seconds, certainly backs up the promises for speed. Its ability to dig ditch in all kinds of tight places has been demonstrated on a variety of jobs. Ditches that had to go close to curbs, between buildings, down narrow alleys, close to trees and poles presented no more difficulty to this Buckeye than would open cross-country digging.



The Buckeye Model 12 Ditcher with a top speed of 1-ft. in six seconds, often cuts days from the working time on many a pipe line job.

Ditch that runs close to poles, curb, and other obstacles presents no difficulty to a Buckeye Model 12 Ditcher.

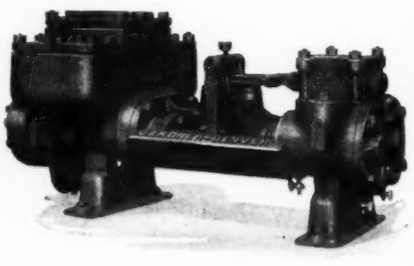
Its eight instantly available digging speeds (from 27 inches to 123 inches per minute) every foot of trench can be dug at the maximum practical speed permitted by the nature of the soil and other operating conditions.

Separate control levers for each wheel make for easy steering. Although it has full-length alligator traction units, the machine can be turned completely around within the radius of its length.

Overall width of this machine is only 61 inches, with a 58-inch width over the alligator wheels. When cutting a 22-inch ditch, the machine extends only 19½ inches beyond the edge of the ditcher. From the center of the ditch the outside of the alligator wheels measures only 29 inches.

Small High Pressure Steam Pump

A SMALL high pressure steam pump of the "Valve Pot Type" is a recent addition to the Gardner-Denver Company, Quincy, Ill., line of pumps. It should prove popular where small capacities are required for moderately high pressures.



The master size is 4½ x 2 x 4, but 2½ and 3-inch fluid pistons are also available. The fluid end is suitable for 500 pounds maximum pressure and is made of high tensile chrome nickle mixture.

This pump is suitable for a wide variety of applications, such as boiler feeding, refinery service, blending in gasoline plant work, oil and gasoline line service where small quantities of fluid are to be handled, handling chemicals in refining processes, and similar uses.

A. I. M. E. Meeting

Symposiums on porosity and related factors and on present and proposed bases of proration were features of the Regional Meeting of the American Institute of Mining and Metallurgical Engineers held at the Biltmore Hotel in Los Angeles on July 28, 1932. The meeting was held jointly by the Southern California and San Francisco sections of the Institute and preceded the opening of the Olympic Games. Over 80 engineers from both sections were in attendance at the technical sessions, while ladies graced an informal dinner held at the University Club on the evening of the 29th.

The first paper delivered was on "Basic Economic Principles Applied to the Petroleum Industry," by L. P. Stockman, of the Independent Oil Producers' Agency.

The symposium on porosity and related factors gave details of recent work on this subject and consisted of three papers: (a) "Porosity and Permeability of Rocks" by F. G. Tickell, O. E. Machem and R. C. McCurdy of Stanford University; (b) "Development of Hydrogen Porosimeter" by C. J. Coberly of Kobe, Inc., and A. B. Stevens of the University of Southern California; and (c) "Relation Between Porosity and Density" by W. O. Smith of Pittsburgh, Penn. These were presented with graphs and other illustrations, together with photographs of apparatus used.

A treatise on the relation of production engineering to oil field operations and personnel prepared by E. W. Griswold of the Continental Oil Company of Ponca City, Okla., compared the organization of engineering staffs as the advisory type, the separate organization type, and the blended type. Coöperation between engineers and the production department was, of course, stressed.

Four papers comprised the symposium on present and proposed bases of proration. The first of these, by Joseph Jensen, of the Associated Oil Company, gave the history of "Oil Curtailment in California." This was followed by a discussion of "Proration on the Basis of Uniform Allowable Gas Production" by R. M. Barnes and A. H. Bell of the Continental Oil Company; "Proration Based on Reservoir Content," by John F. Dodge of the University of Southern California; and "Reservoir and Bottom-Hole Producing Pressures as a Basis of Proration" by C. V. Millikan of the Amerada Petroleum Corporation of Tulsa, Okla.

The technical sessions were concluded by a description of equipment and methods used in "The Killing and Well History of Milham Elliott No. 1 and Continental Elliott 12-8 wells on the North Dome of Kettleman Hills, California," by R. A. Silent of Doheny Stone Drill Company and N. A. Rousselot of the Milham Exploration Company.

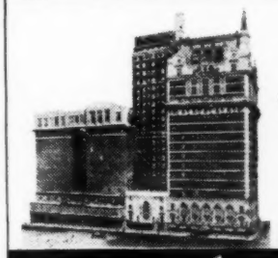
Neilan Announces New Distributor

Neilan Company, Ltd., of Los Angeles, manufacturers of the automatic regulating and control equipment, announce the appointment of the O'Brien Steam Specialty Company of Syracuse, New York, as exclusive representatives for western and northern New York State.

Beg Pardon

In the "Running Tour With Men in the Industry" column of our June issue it was stated that W. P. Hickman of the Barrett Company had been transferred from Chicago to Birmingham, Ala. This was an error as Mr. Hickman is still located at the company's Chicago office, 2800 South Sacramento Avenue.

ADJUSTED RATES



Throughout the Petroleum Industry, *The Adolphus Hotel* is recognized as Dallas Headquarters. Make it your stopping place, too!

"Preferred by Those Knowing"

The Adolphus

Otto Schubert, Jr., Mgr.

DALLAS' FINEST HOTEL

FISHER TRADE MARK

The Most Complete Line of Modern Automatic Control Specialties

WRITE FOR CATALOG

FISHER GOVERNOR CO.

201 S. FIRST AVE. • MARSHALLTOWN, IOWA
1015 SANTA FE AVE. • LOS ANGELES, CALIF.

LUFKIN TAPES

"Atlas"
The World's Best Gauging Tape

"Challenge"
for Engineering, Strapping and General Measuring

Send for Catalog covering complete line.

THE LUFKIN RULE CO. SAGINAW, MICH.
106 LaFayette St., New York City

The Petroleum Engineer Publishing Company,
P. O. Box 1589, Dallas, Texas.

Date .....

Enter my subscription to The Petroleum Engineer from above date for one year, to be sent to me at address below, for which I hereby hand you (check) (cash) in the amount of $1.00 ($1.65 in Canada).

Name .....

Company .....

Title .....
(To avoid delay, please do not fail to state your title.)

Street or Box No. .....

City ..... State .....

Country .....

Selecting the Proper Motor F

By T. D. WI

AN article entitled "Selecting the Proper Motor for the Application," which appeared in a recent issue of THE PETROLEUM ENGINEER, was written to present the electrical characteristics of various types of squirrel cage motors, and thus assist the oil company engineer and superintendent to select the motor best suited to the requirements.

Another equally important factor should be considered in the mechanical construction of the enclosing frame. Originally but one type of frame was built by motor manufacturers—the well known open frame, of which hundreds of thousands are in use. With the development of a wider range of applications for electric motors, and more careful consideration of the economic features, motor manufacturers have been required to design and build a variety of enclosing frames. These are subject to continual change and additions as new duties and requirements are discovered.

Some of the advantages and economies which brought about the development of these enclosing frames are:

(a) Decreased repair expense.

(b) Decreased fire or explosion hazard.

(c) Elimination of pump buildings.

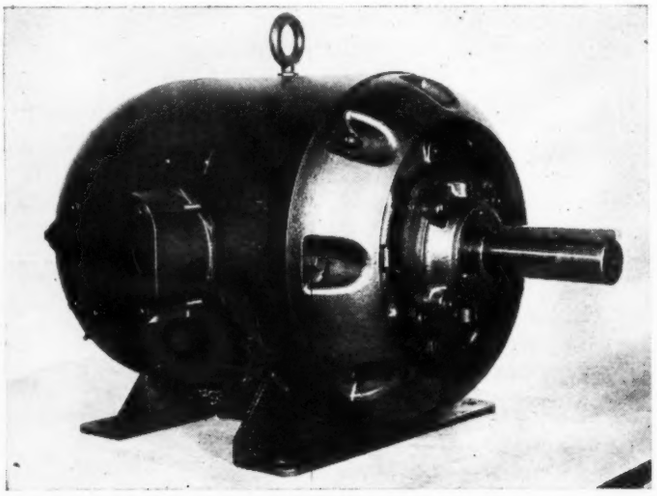
(d) Cooler machines, resulting in longer life.

(e) Preventing moisture from entering windings.

(f) Higher operating efficiency.

(g) Reduced total installation expense.

To summarize these economic advantages, greater service, at less horsepower-hours operating cost, and greater production with fewer failure shut-downs, is secured by selecting the proper frame for the application.



Explosion Proof Frame

The following table furnishes a list of the standard enclosing frames, which are now supplied by all leading motor manufacturers. A tabulation of some of the applications in which these special frames are used, and the relative first cost, as compared with the open type frame, are also given.

Frame	*Application*	*First Cost in % of Open Type*
A. OPEN	Any indoor installation which is relatively clean and dry.	100%
B. SEMI-ENCLOSED		
(1) Drip Proof	Indoor locations, subject to dropping water or falling rocks and foreign materials.	103%
(2) Splash Proof	Indoor locations, subject to splashing water from floor — such as pump rooms, dairies, etc., where floors are washed with a hose.	103%
C. TOTALLY ENCLOSED		
I. WEATHER PROOF		
(1) Fan Cooled	Outdoor installations. Indoor locations where acid fumes or explosive dust is present.	140%
(2) Pipe Ventilated	Indoor installations where room temperatures are excessively high.	115%
(3) Not Mechanically Cooled	Outdoor installations. Indoors, under similar conditions as (1) above but where room temperatures are relatively low.	200%
II. EXPLOSION PROOF		
(1) Fan Cooled	Indoors or outdoors in atmospheres containing explosive gases or vapors.	155%
(2) Not Mechanically Cooled	Same conditions as (1) above, but atmospheric temperatures must not be excessively high.	215%

Open-Standard Frame

As previously stated, all squirrel cage motors were originally built in the open type frame. Many of these motors have been in operation for a number of years, and even under adverse conditions, have given satisfactory service. A certain amount of rewinding had to be done, but this was considered the normal wear, and the maintenance cost was to be expected. However, engineers and superintendents now realize that excessive repair and rewinding costs may be entirely eliminated through the use of proper enclosing frame, which will adequately protect the windings. While open type motors will be used in clean, dry locations, the tendency is toward the enclosed types, for there are comparatively few locations where elements are not present which attack the winding insulation, and eventually cause failure.

Semi-Enclosed Frame

This is a modification of the open-frame motor, which provides protection for the interior of the motor against direct contact of liquids and other foreign substances.

The enclosure for drip proof specifications consists of shields built over the top and sides of the frame, preventing moisture or falling materials from entering the machine from above. This machine is applicable in rooms having overhead steam or water lines, which are subject to sweating or possible leakage, or other locations where there is the possibility of materials falling on the motors.

The splash-proof frame is similar to the drip-proof construction, with the added precautions that water cannot enter the motor unless directed at an angle of more than ten degrees below horizontal. This construction is provided for such locations as pump rooms, which are washed down with a hose,

☆Petroleum Electric Company.

Frame for the Application

WILLIAMSON☆

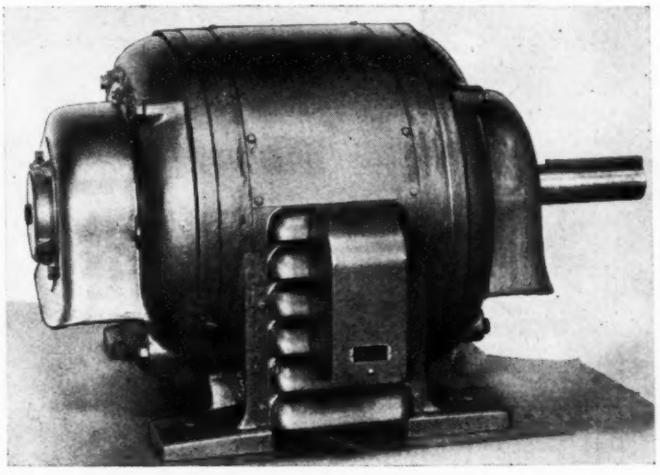
and there is the possibility of water splashing on the motor frame.

Both of these types of motors should be installed indoors, where they are protected against weather conditions. The rooms should be relatively clean, for dust, fumes and foreign particles can enter the motor almost as readily as in the open type motor.

Totally-Enclosed Frame

The prediction has been made by engineers that eventually all motors will be built in totally enclosed frames, regardless of the location in which they are installed. This would insure a much longer life for the average motor, for with the totally enclosed construction, no foreign substances can enter the winding, hence deterioration of the insulation, and the possibility of failure is reduced to a minimum.

The totally enclosed, fan cooled motor was originally designed for use in grain elevators and flour mills, in rooms where an explosive dust is present. The National Board of Fire Underwriters has approved this design for use under the above hazardous conditions. In the petroleum industry the totally enclosed, fan cooled motor was first applied to outdoor installations, driving centrifugal pumps. This application proved to be a very economical one, for the cost of a pump house was entirely eliminated, and in addition, by locating the motor-pump unit adjacent to the equipment with which it is to be used (cooling tower, absorber, etc.), the length of piping and number of fittings required are greatly reduced. These motors are applicable to inside locations where explosive dust or acid fumes are present. This is particularly true in carbon black plants, where the air is filled with particles of carbon. This carbon is a conductor of electricity, and if allowed to deposit on the windings of a motor, will soon cause a short circuit, and the destruction of the windings.



Drip and Splash Proof Frame

In the design of the totally enclosed, fan cooled motor, the heat generated in the interior of the motor is conducted to the outer surface, through the iron, around which the coils are wound, and is then dissipated by the draft of air, forced over the frame by the fan attached to one end of the shaft. It is, therefore, readily understood that if the temperature of the room in which the motor is installed is excessively high, adequate cooling effect could not be provided for the totally enclosed, fan cooled machine. Where this condition of excessive room temperature obtains, the totally enclosed, pipe ventilated motor or special insulation should be used.

The pipe ventilated motor consists of an enclosed frame, with attachment for a vent pipe, which connects with the outside of the building. Air is forced through this vent pipe either by means of a motor-driven blower located at the intake end of the pipe, or by fans attached to the rotor of the motor. After passing through the motor windings, the cooling air is discharged into the room. Although the windings are not totally enclosed, as in the case of the totally enclosed, fan cooled motor described above, foreign substances are prevented from entering the motor, while running, by the forced draft of cooling air. This type of frame is applicable to conditions of high room temperatures, and also in rooms containing dust and acid fumes.

The totally enclosed, non-ventilated type may be used indoors or out of doors, under conditions where it is advisable to keep moisture and foreign substances out of the windings. For a given horsepower and revolutions per minute, the frame of this type of motor is much larger than that of either the fan cooled or pipe ventilated totally enclosed machines, and the first cost is correspondingly higher. This is because the dissipation of heat, generated in the windings and interior of the motor must be accomplished entirely by conduction through the iron of the frame, to the outside of the frame, and the normal radiation from the exterior of the machine.

Explosion Proof Frame

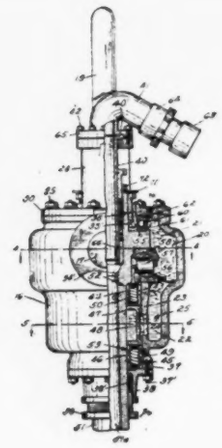
This type of frame is the result of the desire of oil company engineers and superintendents to secure a higher degree of safety, under certain operating conditions, and a ruling of the National Board of Fire Underwriters regarding the use of electric motors in rooms which contain explosive gases or vapors. These frames are built in accordance with the specifications of the Fire Underwriters, and must be tested and approved by them before they may be used under the conditions outlined above. Through the use of the "approved" frames in locations required by the Fire Underwriters the insurance rate is materially decreased, and the fire hazard is practically eliminated.

This frame is similar in construction details to the totally enclosed, fan cooled type. Greater strength is provided, where necessary, to insure against breakage of the frame, should an explosion occur within the motor, and the construction is designed to prevent propagation of sparks or flame from the inside of the motor to the exterior atmosphere.

This type is applicable to such locations as gasoline and oil pump rooms, gas compressor rooms and buildings containing any explosive fumes or gases. It may also be used out of doors, as the construction is thoroughly weather-proof. Because of the heavier and more exacting construction, this type is somewhat more expensive than the totally enclosed, fan cooled type, but the difference in first cost is soon offset by the saving in insurance rates, as set up by the Fire Underwriters.

The explosion proof, not mechanically cooled frame is similar to the fan cooled type, but larger in size for the corresponding rating of horsepower and revolutions per minute of the fan cooled type.

NEW PATENTS OF THE INDUSTRY

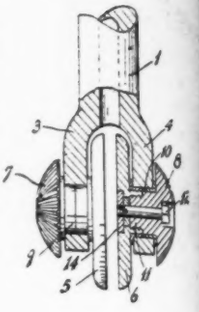


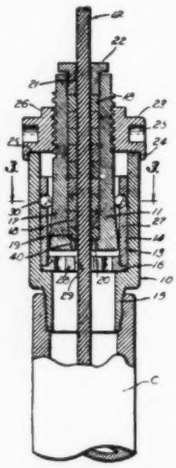
1,861,485. SWIVEL HAVING COOLING MEANS. GUGLIELMO TREMOLADA, Hollywood, Calif., assignor to Emsco Derrick & Equipment Company, Los Angeles, Calif., a Corporation of California. Filed Feb. 25, 1929. Serial No. 342,637. Six Claims (Cl. 255-25.)

1. In a swivel, the combination of: a body providing a lubricant chamber; a sleeve rotatable in said chamber; bearing means in said chamber below the normal lubricant level; sealing means for preventing a leakage of lubricant around said sleeve; and means providing a vapor chamber above said lubricant chamber and above the normal lubricant level, into which vapor from said lubricant chamber may rise.

1,867,545. DISK BIT AND REAMER. SWAN M. AKEYSON, Long Beach, Calif. Filed April 28, 1930. Serial No. 447,787. Four claims. (Cl. 255—71).

1. A disk bit and reamer comprising a shank, a pair of spaced legs depending from the shank, a disk cutter journaled on the inside of each of the legs, a reaming cutter on the outside of the legs, said reaming cutter being of lesser diameter than said disk, said reaming cutter being secured to the disk whereby the disk and reaming cutter will rotate together.



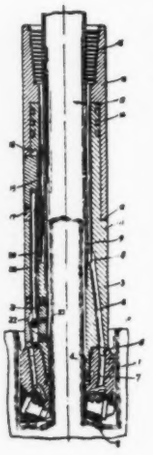


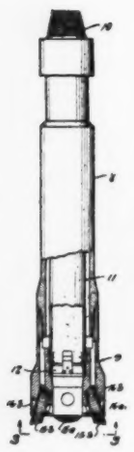
1,867,559. OIL SAVER. ERNEST J. BECK, Long Beach, Calif., assignor to Blackwell & Sunde, Incorporated, Long Beach, Calif., a Corporation of California. Filed March 23, 1931. Serial No. 524,606. Twelve claims. (Cl. 286—16).

1. An oil saver of the character described including a tubular body adapted to be mounted on the upper end of a well casing, a packing gland for packing about an object extending through the body, and means for releasably retaining the packing gland in the body, said means including a sleeve in the body surrounding the packing gland, and balls carried by the sleeve to wedge between the gland and body.

1,867,721. CORE CATCHER. LOUIS H. WELLENSIEK, Houston, Texas, assignor to Hughes Tool Company, Houston, Texas, a Corporation of Texas. Filed January 10, 1929. Serial No. 331,526. Fourteen claims. (Cl. 255—72).

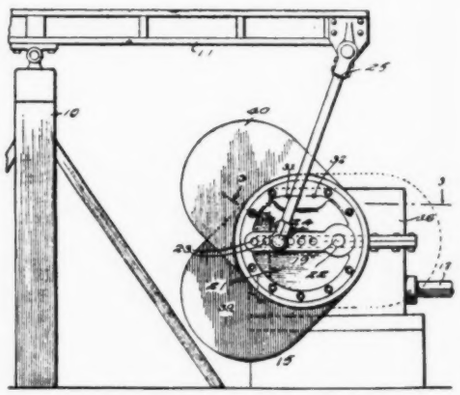
11. In a core drill, a drill collar, a core barrel, core engaging means below said core barrel in said collar, and means actuated by the weight of the drill and core barrel to force said core engaging means into contact with the core.





1,867,628. ROLLER BIT. JOHN T. PHIPPS, Huntington Park, Calif., assignor, by mesne assignments, to Globe Oil Tools Company, Los Angeles, Calif., a Corporation of California. Filed September 27, 1929. Serial No. 395,574. Three claims. (Cl. 255—72).

1. A rotary drilling tool having roller cutters, comprising a body with a cavity for a cutter and provided with cavity side walls having alined cylindrical bores for a cutter journal pin with a counterbore at one end oblique to the main axis of said bores, a cutter journal pin detachably mounted therein having a head at one end and a washer set in said counterbore and secured at its other end to said pin whereby said pin is secured against rotary and longitudinal movement, and a cutter journalled on said pin.



1,868,028. COUNTERBALANCE FOR WELL PUMPS. ALVA L. SKINNER, Bridgeport, Ill. Refiled for abandoned application Serial No. 322,467, filed November 28, 1928. This application filed February 17, 1930. Serial No. 429,168. Fourteen claims (Cl. 74—71).

6. In a counterbalancing device for well pumping apparatuses, a shaft, an eccentric on the shaft, a plurality of weights mounted on the eccentric for movement in parallel planes, and means for simultaneously moving the weights in opposite directions.